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ABSTRACT

Developed for use in teaching a two-semester, one-unit course, this course guide is intended to aid the high school instructor in teaching mathematical problem-solving and computational skills to vocational education students. The state-adopted textbook for general mathematics III, "Applied General Mathematics" serves as the major resource material. The course guide contains a course outline for the nine units, master lists of competencies in vocational mathematics and performance objectives, and the teaching units or lessons, comprised of practical applications of the competencies. The units cover solving problems with a calculator; linear measurement; measurement--capacity, mass, temperature; introduction to basic algebra; ratio, proportion, and percent; graphs and tables; geometry; money and time; and measurement--area and volume. Each unit is composed of 2 to 16 competencies. For each competency, some or all of the following are provided: performance objective, sample item(s), notes, reference to text, evaluation, answers to evaluation, applications for the performance objective (problems to be solved), and answers to applications. (YLB)

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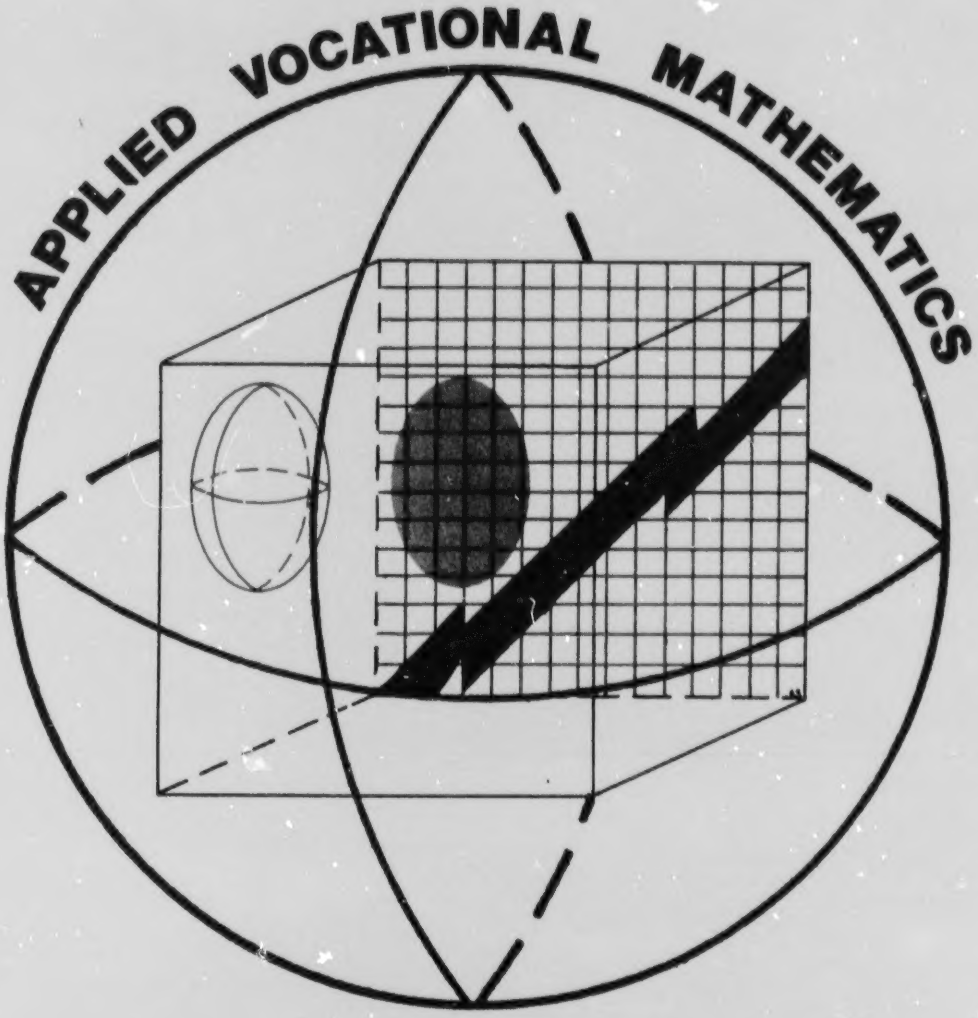

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# PREFACE

**Applied Vocational Mathematics** is based on the premise that mathematics is not a discipline that can be transferred to students solely through conditioning. It is, rather, a discipline which requires exploration. This exploration can be exciting, unpredictable, mysterious, complex, and creative! Ideally, students who successfully complete the course will agree with George Cantor when he declared: "The essence of mathematics is its freedom."

# INTRODUCTION

## Purpose

**Applied Vocational Mathematics** was developed to aid the high school instructor in teaching mathematical problem-solving and computational skills to vocational education students. Numerous practical applications of mathematical principles are provided as the core of the learning activities.

## Organization

**Applied Vocational Mathematics** is a course guide to be used in teaching a two-semester, one-unit course. The state-adopted textbook for General Mathematics III -- **Applied General Mathematics** (1982, Delmar Publishers, Inc.) -- serves as the major resource material. The course guide contains:

--a course outline
--a master list of competencies in vocational mathematics
--a master list of performance objectives, based on the competencies
--teaching "units" or "lessons," comprised of practical applications of the competencies.

An evaluation component is included in each unit.

Although computer literacy is not included in the course outline, exposure to **Computer Literacy** (1983, State Department of Education, Office of Vocational Education) is recommended.

## COURSE OUTLINE

- I. Solving Problems With a Calculator
  - A. Estimation
    - 1. Place value
    - 2. Rounding
    - 3. Estimating sums, differences, products, and quotients
  - B. Solving Problems by Adding Whole Numbers
  - C. Solving Problems by Subtracting Whole Numbers
  - D. Solving Problems by Multiplying Whole Numbers
  - E. Solving Problems by Dividing Whole Numbers
- II. Linear Measurement
  - A. Customary System
    - 1. Reading a ruler
    - 2. Common fractions
      - a. meaning
      - b. comparison
      - c. equivalent
      - d. operations
    - 3. Converting within customary system
    - 4. Perimeter
  - B. Metric System
    - 1. Reading a ruler
    - 2. Decimal fractions
      - a. meaning, reading, writing
      - b. comparison
      - c. converting to common fractions and vice versa
      - d. operations

        3. Converting within metric system
        4. Perimeter
    C. Tolerance
    D. Reading Micrometers

III. Measurement -- Capacity, Mass, Temperature
    A. Measuring Capacity With Customary Units
    B. Measuring Capacity with Metric Units
    C. Measuring Mass With Customary Units
    D. Measuring Mass With Metric Units
    E. Reading Fahrenheit and Celsius Thermometers

IV. Introduction to Basic Algebra
    A. Solving Formulas
    B. Signed Numbers
    C. Powers and Roots (Exponents and Radicals)
    D. Scientific Notation

V. Ratio, Proportion and Percent
    A. Simplifying Ratios
    B. Writing and Solving Proportions
    C. Scale Drawings
    D. Changing Percent to Decimals or Common Fractions and Vice Versa
    E. Solving Percent Problems

VI. Graphs and Tables
    A. Locating Points in a Coordinate Plane
    B. Reading Tables
    C. Interpolation
    D. Reading and Interpreting Line, Bar and Circle Graphs

VII. Geometry

A. Lines

1. Perpendicular

2. Parallel

B. Angles

1. Classifying angles

2. Identifying pairs

3. Measuring

4. Drawing

C. Triangles

1. Classify

2. Identify parts

3. Sum of angles

4. Similar

5. Trigonometry

a. Sine, cosine, tangent functions

b. Reading trigonometry tables

c. Solving problems

D. Quadrilaterals

1. Identification

2. Characteristics

E. Circles

1. Parts

2. Characteristics

3. Circumference

VIII. Money and Time

- A. Computing Salaries
- B. Completing Invoices

IX. Measurement — Area and Volume

- A. Area of Triangles, Parallelograms, Circles
- B. Area of Irregular Figures
- C. Surface Area of Rectangular Solids and Cylinders
- D. Volume of Rectangular Solids and Cylinders

# Master List of COMPETENCIES

The student is required to demonstrate mastery of the following competencies in order to complete successfully the course in **Applied Vocational Mathematics.**

| **Course Outline** | | **Competencies** |
|---|---|---|
| IA | 1. | Determine place value to hundred thousands. |
| IA | 2. | Round whole numbers to a designated place value. |
| IA | 3. | Estimate sums, differences, products and quotients. |
| IB-E | 4. | Solve problems that require computations with whole numbers. |
| IB-E | 5. | Use a calculator to solve problems. |
| IIA | 6. | Read a customary-unit ruler. |
| IIA | 7. | Explain the meaning of common fractions. |
| IIA | 8. | Compare fractions. |
| IIA | 9. | Give equivalent fractions. |
| IIA | 10. | Add, subtract, multiply and divide fractions. |
| IIA | 11. | Make conversions within the customary system of measurement. |
| IIA | 12. | Find the perimeter of polygons using customary units. |
| IIB | 13. | Read a metric ruler. |
| IIB | 14. | Read and write decimals. |
| IIB | 15. | Compare decimals. |
| IIB | 16. | Convert decimals to common fractions and vice versa. |
| IIB | 17. | Add, subtract, multiply and divide decimals. |
| IIB | 18. | Make conversions within the metric system. |
| IIB | 19. | Find the perimeter of a polygon using metric units. |
| IIC | 20. | Explain and use tolerance. |
| IID | 21. | Read metric and customary micrometers. |
| IIIA | 22. | Measure capacity with customary units. |

|  |  |  |
|---|---|---|
| IIIB | 23. | Measure capacity with metric units. |
| IIIC | 24. | Measure mass with customary units. |
| IIID | 25. | Measure mass with metric units. |
| IIIA-D | 26. | Make conversions within systems among capacity units and among mass units. |
| IIIE | 27. | Read Fahrenheit and Celsius thermometers. |
| IVA | 28. | Solve formulas. |
| IVB | 29. | Explain meaning of signed numbers. |
| IVC | 30. | Evaluate expressions with powers and roots. |
| IVD | 31. | Read and write numbers in scientific notation. |
| VA | 32. | Write and simplify ratios. |
| VB | 33. | Write and solve proportions. |
| VC | 34. | Interpret and use scale drawings. |
| VD | 35. | Write equivalent forms of percents, decimals and common fractions. |
| VE | 36. | Solve percent problems. |
| VIA | 37. | Locate points in a coordinate plane. |
| VIB | 38. | Read information from a table. |
| VIC | 39. | Interpolate to find information missing from a table. |
| VID | 40. | Read and interpret line, bar and circle graphs. |
| VIIA | 41. | Identify perpendicular lines. |
| VIIA | 42. | Identify parallel lines. |
| VIIA | 43. | Tell relationships of angles formed by perpendicular and parallel lines. |
| VIIB | 44. | Classify angles according to their measures. |
| VIIB | 45. | Identify angle pairs and state relationships regarding angle measures. |
| VIIB | 46. | Measure angles. |
| VIIB | 47. | Draw angles. |

|  |  |  |
|---|---|---|
| VIIC | 48. | Classify triangles according to the length of their sides and the measure of their angles. |
| VIIC | 49. | Identify the parts of triangles. |
| VIIC | 50. | Find missing angle of a triangle. |
| VIIC | 51. | Identify similar triangles and find the missing side. |
| VIIC | 52. | Use sine, cosine and tangent functions. |
| VIIC | 53. | Read trigonometric tables. |
| VIID | 54. | Identify quadrilaterals. |
| VIIE | 55. | Identify the parts of a circle and tell the characteristics. |
| VIIE | 56. | Find the circumference of a circle. |
| VIIIA | 57. | Compute salaries. |
| VIIIB | 58. | Complete invoices. |
| IXA | 59. | Find the area of a triangle, parallelogram or a circle. |
| IXB | 60. | Find the area of irregular figures. |
| IXC | 61. | Find the surface area of rectangular solids and cylinders. |
| IXD | 62. | Find the volume of rectangular solids and cylinders. |

# Master List
# Of
# PERFORMANCE OBJECTIVES

The student is required to perform successfully the following objectives in order to demonstrate mastery of the competencies upon which **Applied Vocational Mathematics** is based. A suggested guideline to follow in measuring mastery is 75% accuracy in the completion of the section labeled EVALUATION located at the close of each lesson.

| **Course Outline** | | **Performance Objectives** |
|---|---|---|
| IA | 1. | Given a six-digit whole number, state the place value of each digit. |
| IA | 2. | Given a six-place whole number, round the number to a designated place value. |
| IA | 3. | Given two four-digit numbers, estimate the sum and difference to the nearest hundred. |
| IA | 4. | Given a three-digit number and a one-digit number, estimate the product and quotient to the nearest ten or hundred. |
| IB | 5. | Given a calculator, solve application problems that require adding whole numbers. |
| IC | 6. | Given a calculator, solve application problems that require subtracting whole numbers. |
| ID | 7. | Given a calculator, solve application problems that require multiplying whole numbers. |
| IE | 8. | Given a calculator, solve application problems that require dividing whole numbers. |
| IIA | 9. | Given a line segment and a ruler, measure the length of the segment to the nearest sixteenth of an inch. |
| IIA | 10. | Given a common fraction, draw a pictorial representation. |
| IIA | 11. | Given two common fractions, tell which is larger, or state that they are equivalent. |
| IIA | 12. | Given a common fraction and a new denominator, write an equivalent fraction. |
| IIA | 13. | Given any combination of fractions, mixed numbers and whole numbers, find the sum. |
| IIA | 14. | Given any combination of fractions, mixed numbers and whole numbers, find the difference. |

| | | |
|---|---|---|
| IIA | 15. | Given any combination of fractions, mixed numbers and whole numbers, find the product. |
| IIA | 16. | Given any combination of fractions, mixed numbers and whole numbers, find the quotient. |
| IIA | 17. | Given a linear measure in the customary units, write an equivalent measure in another unit. |
| IIA | 18. | Given a polygon with dimensions in customary units, find the perimeter. |
| IIB | 19. | Given a line segment and a ruler, measure the length of the segment to the nearest millimeter. |
| IIB | 20. | Given a list of decimal fractions in numerical form and a list in word form, match equivalent forms. |
| IIB | 21. | Given two decimal fractions, tell which is larger, or state that they are equivalent. |
| IIB | 22. | Given a list of common fractions and a list of decimal fractions, match equivalent forms. |
| IIB | 23. | Given two decimal numbers, find the sum. |
| IIB | 24. | Given two decimal numbers, find the difference. |
| IIB | 25. | Given two decimal numbers, find the product. |
| IIB | 26. | Given two decimal numbers, find the quotient. |
| IIB | 27. | Given a linear measure in metric units, write an equivalent measure using a different unit. |
| IIB | 28. | Given a polygon with dimensions in metric units, find the perimeter. |
| IIC | 29. | Given a measurement in metric or customary units and the tolerance, state the acceptable measures. |
| IID | 30. | Given a metric or customary micrometer and an object to be measured, measure the stated dimension to the nearest thousandth of an inch or hundredth of a millimeter. |
| IIIA | 31. | Given a container and a specified customary unit, determine the capacity to the nearest half-unit. |
| IIIB | 32. | Given a container and specified metric unit, determine the capacity to the nearest half-unit. |
| IIIC | 33. | Given an item and a specified customary unit, determine its mass to the nearest half-unit. |

| | | |
|---|---|---|
| IIID | 34. | Given an item and a specified metric unit, determine its mass to the nearest half-unit. |
| IIIA-D | 35. | Given a customary capacity or mass measurement, write an equivalent customary measurement using a different unit. |
| IIIA-D | 36. | Given a metric capacity or mass measurement, write an equivalent metric measurement using a different unit. |
| IIIE | 37. | Given a Fahrenheit or Celsius thermometer, read the temperature to the nearest half-degree. |
| IVA | 38. | Given a formula and values for all but one variable, solve the formula to find the value of the remaining variable. |
| IVB | 39. | Given a list of positive and negative numbers and a list of interpretations, match the number to the meaning. |
| IVC | 40. | Given an expression with an exponent or radical, write its value without an exponent or radical. |
| IVD | 41. | Given a list of numbers written in scientific notation and a list of numbers in expanded form, match the scientific notation expression with its expanded form. |
| VA | 42. | Given a verbal statement containing a ratio, write the ratio in numerical form and simplify it. |
| VB | 43. | Given a verbal problem, write a proportion to solve the problem. |
| VB | 44. | Given a proportion with one unknown, solve the proportion. |
| VC | 45. | Given a scale drawing, write and solve a proportion to find unknown lengths. |
| VD | 46. | Given a percent, write the equivalent common fraction and decimal. |
| VD | 47. | Given a decimal, write the equivalent common fraction and percent. |
| VD | 48. | Given a common fraction, write the equivalent percent and decimal fraction. |
| VE | 49. | Given a percent problem, find the missing rate, base or part. |
| VIA | 50. | Given a list of ordered pairs and a set of points in a coordinate plane, match one set of ordered pairs to the points. |
| VIB | 51. | Given a table, answer questions pertaining to the information in the table. |
| VIC | 52. | Given a table, interpolate to find a value between two given values. |
| VID | 53. | Given a line graph, answer questions pertaining to the information in the graph. |

VID 54. Given a bar graph, answer questions pertaining to the information in the graph.

VID 55. Given a circle graph, answer questions pertaining to the information in the graph.

VIIA 56. Given pairs of parallel and perpendicular lines, identify each.

VIIA 57. Given a pair of parallel lines cut by a transversal and the measure of one angle which is formed, find the measures of the other seven angles.

VIIB 58. Given an angle (drawing or measure), classify it as acute, obtuse, straight or right.

VIIB 59. Given drawings of supplementary, complementary, vertical and adjacent angles, identify each pair of angles.

VIIB 60. Given the measure of one angle in a pair of supplementary, complementary or vertical angles, find the measure of the other angle.

VIIB 61. Given an angle and a protractor, find the measure of the angle to the nearest half-degree.

VIIB 62. Given a protractor, draw an angle of given measure correct to the nearest half-degree.

VIIC 63. Given a triangle, classify it as acute, obtuse, right, scalene, isosceles, or equilateral.

VIIC 64. Given a triangle, locate the medians, altitudes and angle bisectors.

VIIC 65. Given a right triangle, identify the legs and hypotenuse.

VIIC 66. Given the measures of two angles of a triangle, find the measure of the third angle.

VIIC 67. Given two triangles, tell whether or not they are similar.

VIIC 68. Given two similar triangles and the ratio of the lengths of the sides, find the length of the missing side.

VIIC 69. Given a right triangle, write the sine, cosine and tangent ratios.

VIIC 70. Given a table of trigonometric values, answer questions pertaining to the table.

VIIC 71. Given right triangles, use the sine, cosine and tangent functions to find missing sides and angles.

VIID 72. Given a set of quadrilaterals, identify each as a parallelogram, square, rectangle, rhombus or trapezoid.

| | | |
|---|---|---|
| VIIE | 73. | Given a circle, identify radius, diameter, chords, arcs, central angle and inscribed angle. |
| VIIE | 74. | Given a circle and the measure of its radius or diameter, find the circumference. |
| VIIIA | 75. | Given a rate of pay, compute a salary for a given pay period. |
| VIIIB | 76. | Given an invoice form and the necessary rates and prices, complete the invoice to determine a price estimate or exact cost. |
| IXA | 77. | Given a triangle, parallelogram, or circle, and the necessary measurements, compute the area. |
| IXB | 78. | Given an irregular polygon and necessary measurements, subdivide the polygon and compute the area. |
| IXC | 79. | Given a rectangular solid or cylinder and the necessary measurements, find the surface area. |
| IXD | 80. | Given a rectangular solid or cylinder and one necessary measurement, find the volume. |

## solving problems with a calculator

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Determine place value to hundred thousands.

## PERFORMANCE OBJECTIVE #1

Given a six-digit whole number, state the place value of each digit.

## SAMPLE ITEMS

1. Which digit is in the thousand's place? 46,723 (ans: 6)
2. In this number, 2 is in what place? 123,456 (ans: ten thousands)

## NOTES

**General:** Students need to be able to read numbers correctly as well as state place value.

**Activity:** Have the students write numbers as the teacher reads them aloud. For example, if the teacher reads nine thousand seven hundred six, the student would write 9,706.

**Masonry:** Brick masons use numbers up to about 50,000. The numbers could refer to bricks, area, length, money, or measurements for mortar.

**Air Conditioning/Refrigeration:** Whole numbers are needed so that students can compute and state values up to hundreds of thousands. Examples are:

1. Reading an ohmmeter with a scale of 100K. If meter indicates 8.25, then 8.25 x 100K or 825,000 ohms.
2. Air movement is measured in units of cubic feet per minute per ton of air conditioning. 400CFM/Ton x 40 Tons = 16,000 CFM.
3. Heat energy is measured in British Thermal Units (BTU). Heat loss from a building would be stated 528,295 BTU.

## REFERENCE TO TEXT

**Applied General Mathematics** (AGM) by Delmar Publishers, pages 1-7

## EVALUATION

1. In what place is the digit 3 in each of these numbers?
   a) 314,785
   b) 654,321

2. Which digit is in the thousand's place?
   783,961

3. Which digit is in the ten's place?
   458,762

## ANSWERS TO EVALUATION

1. a) hundred thousands
   b) hundreds
2. 3
3. 6

## ANSWERS TO APPLICATIONS

1. a) eighteen thousand BTU
   b) fifteen thousand, five hundred BTU
   c) sixty-one thousand, three hundred ninety-two BTU
   d) nine hundred eighty-three thousand, four hundred sixty-eight BTU

2. a) fourteen thousand, three hundred twenty-eight BTU
   b) twenty-nine thousand, six hundred forty-two BTU
   c) one hundred eight thousand, six hundred forty-nine BTU

3. a) twenty-four ohms
   b) thirty-three thousand, three hundred ohms
   c) fifty-seven thousand, one hundred twenty-six ohms
   d) nine hundred thirty-two thousand, one hundred sixty-nine ohms

4. a) 415 CFM
   b) 164,600 CFM
   c) 80,002 CFM
   d) 906,428 CFM

5. 
$$\begin{array}{r} 2,425 \\ 663 \\ \underline{9,311} \\ 12,899 \end{array}$$

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## APPLICATIONS
## FOR
## PERFORMANCE OBJECTIVE #1

Performance Objective #1: Given a six-digit whole number, state the place value of each digit.

1. Air conditioning units are rated by the amount of heat energy that can be removed each hour. Read the following rates.
   a) 18,000 BTU
   b) 15,500 BTU
   c) 61,392 BTU
   d) 983,468 BTU

2. Heat energy is lost from a building when the outside temperature is less than the inside temperature. Read the following BTU losses.
   a) 14,328 BTU
   b) 29,642 BTU
   c) 108,649 BTU

3. An ohmmeter is used to measure the value of resistance which is measured in ohms. Read the following resistances.
   a) 24 ohms
   b) 33,300 ohms
   c) 57,126 ohms
   d) 932,169 ohms

4. The volume of air moved by a fan is measured in cubic feet per minute (CFM). Write the following numbers in figures.
   a) Four hundred fifteen CFM
   b) One hundred sixty-four thousand, six hundred CFM
   c) Eighty thousand, two CFM
   d) Nine hundred six thousand, four hundred twenty-eight CFM

5. Add the following numbers. (Hint: Write the numbers out as whole numbers first.) Two thousand four hundred twenty-five plus six hundred sixty-three plus nine thousand eight hundred eleven.

## COMPETENCY

Round whole numbers to a designated place value.

## PERFORMANCE OBJECTIVE #2

Given a six-place whole number, round the number to a designated place value.

## SAMPLE ITEM

Round to the nearest thousand: 76,681 (ans: 77,000)

## NOTES

Rounding is used more with decimals than with whole numbers in vocational areas. Frequently whole numbers are rounded up to ensure proper quantities of materials and for price estimates. Rounding is also used frequently when referring to the capacity of equipment.

## EVALUATION

1. Round to the nearest hundred.
   a) 76,513
   b) 5,981

2. Round to the nearest thousand.
   a) $46,715
   b) $84,593

## ANSWERS TO EVALUATION

1. a) 76,500
   b) 6,000

2. a) $47,000
   b) $85,000

## ANSWERS TO APPLICATIONS

1.

| | Tens | Hundreds |
|---|---|---|
| a) | 5,270 ft. | 5,300 ft. |
| b) | 89,420 ft. | 89,400 ft. |
| c) | 810 ft. | 800 ft. |
| d) | 33,150 ft. | 33,200 ft. |

2.

| | Thousands | Ten Thousands |
|---|---|---|
| a) | 36,000 | 40,000 |
| b) | 145,000 | 140,000 |
| c) | 644,000 | 640,000 |
| d) | 888,000 | 890,000 |
| e) | 70,000 | 70,000 |
| f) | 166,000 | 170,000 |

3. a) $ 5,280
   b) $ 84,250
   c) $ 410
   d) $ 15,850

4. a) 125,600 bricks
   b) $413,800
   c) 213,600 sq. ft.

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #2

Performance Objective #2: Given a six-place whole number, round the number to a designated place value.

1. An electrician has computed requirements for electrical cable. Round the number to the place indicated.

| | | | Round to the Nearest | |
|---|---|---|---|---|
| | Size Cable | Quantity | Tens | Hundreds |
| a) | AWG 14 | 5,266 ft. | | |
| b) | AWG 12 | 89,424 ft. | | |
| c) | AWG 10 | 809 ft. | | |
| d) | AWG 8 | 33,152 ft. | | |

2. An air conditioning contractor determined the heat energy lost from various rooms within a building. Round the number to the place indicated.

| | | | Round to the Nearest | |
|---|---|---|---|---|
| | Room | Quantity | Thousands | Ten Thousands |
| a) | Office A | 36,285 BTU | | |
| b) | Office B | 144,598 BTU | | |
| c) | Warehouse A | 643,754 BTU | | |
| d) | Warehouse B | 888,023 BTU | | |
| e) | Cafeteria | 70,479 BTU | | |
| f) | Equipment Room | 165,902 BTU | | |

3. An inventory was taken of repair parts for cooling systems. Round the numbers to the nearest ten dollars.

| | | |
|---|---|---|
| a) | Coils | $ 5,284 |
| b) | Compressors | $84,251 |
| c) | Tubing | $ 408 |
| d) | Motors | $1[illegible],846 |

4. Round the following numbers to the nearest hundred.

a) 125,635 bricks
b) $413,772
c) 213,550 square feet

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Estimate sums, differences, products and quotients.

## PERFORMANCE OBJECTIVE #3

Given two four-digit numbers, estimate the sum and difference to the nearest hundred.

## SAMPLE ITEMS

1. The sum of 3,671 and 1,924 is closest to:
   a) 5,300
   b) 5,400
   c) 5,500
   d) 5,600
   e) 5,700
   (ans: d)

2. The difference of 3,671 and 1,924 is closest to:
   a) 1,600
   b) 1,700
   c) 1,800
   d) 1,900
   e) 2,000
   (ans: c)

## NOTES

When hand-held calculators are used, answers must be checked for reasonableness by using estimation skills. The teacher can aid in this process by asking questions such as: "Is the answer more or less than 500?" "Will one answer be closer to 1,000 or 1,500?" Estimation should also be used as part of solving word problems.

## EVALUATION

1. The sum of 6,732 and 1,284 is closest to:
   a) 8,000
   b) 9,000
   c) 9,100
   d) 9,200

2. The difference of 6,732 and 1,284 is closest to:
   a) 4,400
   b) 5,400
   c) 5,500
   d) 5,600

3. Estimate this sum to the nearest hundred: 3,514 + 4,625
    a) 8,000
    b) 8,100
    c) 8,200
    d) 8,300

4. Estimate this difference to the nearest hundred: 4,625 - 3,514
    a) 900
    b) 1,000
    c) 1,100
    d) 1,200

## ANSWERS TO EVALUATION

1. a
2. b
3. b
4. c

## ANSWERS TO APPLICATIONS

1. a) 5,000
   b) 8,000
   c) 5,000

2. a) 3,300 oranges
   b) 1,100 oranges

3. 1,700 + 2,300 = 4,000 BTU

4. 2,500 + 1,000 = 3,500 CFM

5. 23,800 - 15,500 = 8,300 BTU

6. a) 135,800 - 133,000 = 2,800 BTU
   b) 151,300 - 135,000 = 15,500 BTU
   c) 146,900 - 143,200 = 3,700 BTU

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #3

Performance Objective #3: Given two four-digit numbers, estimate the sum and difference to the nearest hundred.

1. Circle the best estimate for the answer in each exercise.
   a) 1,532 + 3,418 = ?

      2,000 5,000 8,000

   b) 4,888 + 3,112 = ?

      6,000 7,000 8,000

   c) 3,012 + 2,101 = ?

      4,000 5,000 6,000

2. One worker picked 1,065 oranges and another worker picked 2,176 oranges.
   a) How many to the nearest hundred did they pick together?
   b) How many more to the nearest hundred did the second worker pick?

3. Heat gain calculations have been made on a house. One room has a gain of 1,672 British Thermal Units (BTU's) and another room has a gain of 2,309 BTU's. Estimate to the nearest hundred the total heat gain for the two rooms.

4. A fan is to be selected to move air in a two-story house. The first floor requires 2,469 cubic feet per minute (CFM) and the second floor requires 1,028 CFM. Estimate to the nearest hundred the total quantity of air that the fan must move.

5. Two window air conditioners are for sale. One is rated at 15,525 British Thermal Units per Hour (BTUH) and the other at 23,750 BTUH. Estimate to the nearest hundred the difference in the rating of the two air conditioners.

6. From the table listing the BTU ratings of fuel oil, estimate to the nearest hundred the difference in the heat per gallon.
   a) For No. 1 and No. 2 fuel oil
   b) For No. 2 and No. 6 fuel oil
   c) For No. 4 and No. 5 fuel oil

**BTU Ratings of Fuel Oil**

| Grade | Heat/Per Gal. |
|---|---|
| No. 1 | 132,980 |
| No. 2 | 135,830 |
| No. 4 | 143,150 |
| No. 5 | 146,860 |
| No. 6 | 151,320 |

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Estimate sums, differences, products and quotients.

## PERFORMANCE OBJECTIVE #4

Given a three-digit number and a one-digit number, estimate the product and quotient to the nearest ten or hundred.

## SAMPLE ITEMS

1) Estimate this product to the nearest 100.
   365 x 8
   (ans. 3,200)

2) Estimate this quotient to the nearest 10.
   625 ÷ 7
   (ans. 90)

## NOTES

**General:** See notes for Performance Objective #3. Remind students that to estimate answers, they should round first.

**Air Conditioning/Refrigeration:** Before selecting the size of a heating unit, heat loss calculations must be made. This requires multiplication and division of whole numbers to the nearest hundred.

## EVALUATION

1. Estimate to the nearest hundred: 591 x 4
   a) 2,000
   b) 2,100
   c) 2,400
   d) 2,500

2. Estimate to the nearest hundred: 226 x 6
   a) 1,200
   b) 1,300
   c) 1,800
   d) 2,000

3. Estimate to the nearest hundred: 415 ÷ 4
   a) 120
   b) 110
   c) 100
   d) 10

4. Which of the following is the best estimate for 538 ÷ 6?
   a) 900
   b) 100
   c) 90
   d) 80

## ANSWERS TO EVALUATION

1. c
2. a
3. c
4. c

## ANSWERS TO APPLICATIONS

1. a) 600
   b) 2,500
   c) 400
   d) 200

2.

| | | | |
|---|---|---|---|
| Windows | | 1,800 | BTUH |
| Doors | | 600 | BTUH |
| Net Wall | | 8,000 | BTUH |
| Ceiling | | 5,600 | BTUH |
| Floor | | 4,000 | BTUH |
| Infiltration | W | 400 | BTUH |
| | D | 900 | BTUH |

3. 200"

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #4

Performance Objective #4: Given a three-digit number and a one-digit number, estimate the product and quotient to the nearest hundred.

1. Circle the best estimate for the answer in each exercise.
   a) 3 x 214 = ?

      400 500 600 700

   b) 5 x 498 = ?

      2,000 2,300 2,500 3,000

   c) 813 ÷ 2 = ?

      200 300 400 500

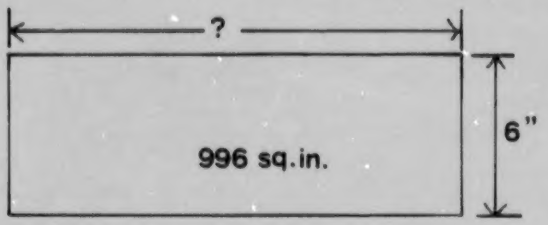
   d) 912 ÷ 6 = ?

      100 200 300 400

2. To determine the BTUH (British Thermal Units per Hour) loss the area is multiplied by the Heat Transfer Factor (HTF). Estimate to the nearest hundred the BTUH loss of each area listed in the left column. Record your answer in the BTUH loss column.

| | AREA | HTF | BTUH LOSS | |
|---|---|---|---|---|
| GROSS WALL | 1239 | | | |
| WINDOWS | 158 | 9 | | |
| DOORS | 109 | 6 | | |
| NET WALL | 972 | 8 | | |
| CEILING | 843 | 7 | | |
| FLOOR | 843 | 5 | | |
| | | | | |
| INFILTRATION W | 147 lin. ft. | 4 | | |
| D | 111 lin. ft. | 9 | | |

3. A sheet of metal contains 996 square inches of area and one side is 6 inches. Estimate to the nearest hundred the length of the other side by dividing the area by the known side.



# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCIES

Solve problems that require computations with whole numbers.
Use a calculator to solve problems.

## PERFORMANCE OBJECTIVE #5

Given a calculator, solve application problems that require adding whole numbers.

## SAMPLE ITEM

A plot of land is divided into 3 lots. The lots measure 12,278 square feet, 18,031 square feet and 14,956 square feet. What is the total area of the plot of land? (ans. 45,265 square feet)

## NOTES

Students entering trade and industry fields should be familiar with using hand-held calculators because they will encounter them in their work and personal lives. When working with whole numbers and decimals, students should be allowed and encouraged to use calculators. Remind students to check their answers for reasonableness by estimating first. Remind students to label their answers when working word problems.

## REFERENCE TO TEXT

**Applied General Mathematics** (AGM), pages 8 - 13

## EVALUATION

1. Jane's sales for the week were $4,276, $5,938 and $1,721. What were her total sales?

2. A truck is carrying 1,175 pounds of plate steel, 352 pounds of I-beams, and 2,285 pounds of iron. What is its total load?

3. A print shop operator printed 8,295 letterheads Monday; 13,670 on Tuesday; 6,918 on Wednesday and 3,720 on Thursday. How many letterheads did he print in the 4 days?

4. The following amounts of cable are used in an apartment house job: 372 meters, 578 meters, 56 meters and 825 meters. What is the total number of meters used?

## ANSWERS TO EVALUATION

1. $11,935
2. 3,812 pounds
3. 32,503 letterheads
4. 1,831 meters

## ANSWERS TO APPLICATIONS

1. $554
2. 5,106 bricks
3. $4,615
4. 88 hours
5. 12,854 + 4,656 + 6,298 + 6,616 + 3,324 + 4,266 + 3,528 + 6,136 + 420 = 48,098 BTUH

## APPLICATIONS
## FOR
## PERFORMANCE OBJECTIVE #5

Performance Objective #5: Given a calculator, solve application problems that require adding whole numbers.

1. A contractor paid $347 for brick, $79 for block, $94 for mortar and $34 for sand. What was his total bill?

2. Five bricklayers working on a house each laid the following number of brick in one day: 1st bricklayer, 895 bricks; 2nd bricklayer, 1,035 bricks, 3rd bricklayer, 947 bricks; 4th bricklayer, 1,211 bricks; 5th bricklayer, 1,018 bricks. What was the total number of brick laid that day?

3. In preparing a bid on a job, a masonry contractor allowed $1,400 for materials, $1,115 for excavating and pouring footings, and $2,100 for labor. What was the total of his bid?

4. A crew of ten workers worked 18 hours, 30 hours and 40 hours. What was the total number of hours worked?

5. On the heating data sheet on the following page, determine the BTUH loss for each area of the house (i.e., L.R., B.R.#1, etc.), item 13, then the total BTUH loss for the entire house.

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## HEATING DATA SHEET

DATE ______ BY ______
OUTSIDE DESIGN TEMP. -2°F
INSIDE DESIGN TEMP. 70°F
DESIGN TEMP. DIFF. 72°F

HEATING CONTRACTOR ______ ADDRESS ______
NAME OF JOB ______ ADDRESS ______

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Room Use and Floor Level | | | | 1. L.R. | | 2. B.R. #1 | | 3. B.R #2 | | 4. B.R #3 | | 5. Bath +½B | | 6. Utility | | 7. KITCHEN | | 8. D.R. | | | |
| 2. Room Length and Width | | | | 18x16 | | 12x13 | | 14x13 | | 14x14 | | 8x14 | | 8x14 | | 8x14 | | 10x14 | | | |
| 3. Running Ft of Exposed Wall | | | | 34 | | 12 | | 27 | | 28 | | 8 | | 8 | | 8 | | 24 | | | |
| 4. Ceiling Height | | | | 8 | | 8 | | 8 | | 8 | | 8 | | 8 | | 8 | | 5 | | | |
| 5. Exposure Type | Table No. | "U" Factor | Multiplier | Area Crack Cfm | Btuh Loss | Area Crack Cfm | Btuh Loss | Area Crack Cfm | Btuh Loss | Area Crack Cfm | Btuh Loss | Area Crack Cfm | Btuh Loss | Area Crack Cfm | Btuh Loss | Area Crack Cfm | Btuh Loss | Area Crack Cfm | Btuh Loss | Area Crack Cfm | Btuh Loss |
| 6. Gross Exposed Wall | | | | 272 | | 96 | | 216 | | 224 | | 64 | | 64 | | 64 | | 192 | | 0 | |
| 7. Windows and Doors W | | | 79 | 40 | 3160 | 18 | 720 | 18 | 720 | 18 | 720 | 12 | 480 | 0 | | 16 | 640 | 36 | 1440 | 0 | |
| D | | | 22 | 21 | 462 | | | | | | | | | 21 | 462 | | | | | | |
| 8. Net Exposed Wall | | | 10 | 221 | 2110 | 78 | 780 | 198 | 1980 | 260 | 2060 | 52 | 520 | 43 | 430 | 48 | 480 | 156 | 1560 | 0 | |
| 9. Cold Partition | | | | | | | | | | | | | | | | | | | | | |
| 10. Cold Ceiling | | | 7 | 288 | 2016 | 156 | 1092 | 182 | 1274 | 196 | 1372 | 112 | 784 | 112 | 784 | 112 | 784 | 140 | 980 | 60 | 420 |
| 11. Cold Floor | | | 10 | 288 | 2880 | 156 | 1560 | 182 | 1820 | 196 | 1960 | 112 | 1120 | 112 | 1120 | 112 | 1120 | 140 | 1400 | 60 | |
| 12. Infiltration, (Leakage) or Air Change | | | 42 | 18 | 756 | 12 | 504 | 12 | 504 | 12 | 504 | 10 | 420 | 0 | | 12 | 504 | 18 | 756 | 0 | |
| | | | 70 | 21 | 1470 | | | | | | | | | 21 | 1470 | | | | | 0 | |
| 13. Room Sub-Total Btuh | | | | | | | | | | | | | | | | | | | | | |

Addition of these answers is total BTUH loss.

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# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCIES

Solve problems that require computations with whole numbers.
Use a calculator to solve problems.

## PERFORMANCE OBJECTIVE #6

Given a calculator, solve application problems that require subtracting whole numbers.

## SAMPLE ITEM

James laid 920 bricks today. John laid 684. How many more bricks did James lay? (ans. 236)

## NOTE

**Air Conditioning/Refrigeration:** When sizing duct for a forced air heating or cooling system, the student must be able to determine how much air is passing through the duct at any given point. To practice this procedure, the student is given a number, subtracts a quantity, records the remainder and continues to subtract additional values from each remainder.

## REFERENCE TO TEXT

**Applied General Mathematics** (AGM), pages 14-20

## EVALUATION

1. Lewis must lay 900 bricks before quitting time. He has laid 642. How many more must he do?

2. To get a commission William must sell $4,200 worth of printing a week. So far he has sold $2,867. How much more must he sell to start making a commission?

3. A 500-foot roll of wire is used in a house. So far strips have been cut that were 74 feet long, 55 feet and 49. How much wire is left?

4. A power supply is designed to produce 525 volts. It is set to 279 volts. How many more volts can it produce?

## ANSWERS TO EVALUATION

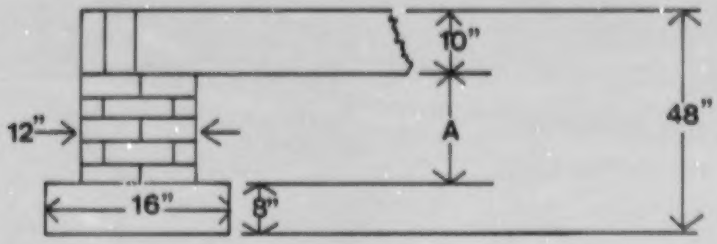
1. 258 bricks
2. $1,333
3. 322 feet
4. 246 volts

## ANSWERS TO APPLICATIONS

1. 30"
2. 4"
3. $347
4. 24'
5. 19'
6. 9'1"
7. After A: 12,659 CFM
   After B: 10,517 CFM
   After C: 8,575 CFM
   After D: 4,346 CFM
   After E: 2,000 CFM

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #6

Performance Objective #6: Given a calculator, solve application problems that require subtracting whole numbers.

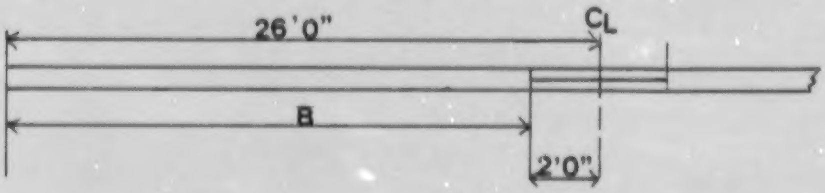


1. Using the drawing above, what is the dimension "A"?

2. How much wider is the footing than the pier?

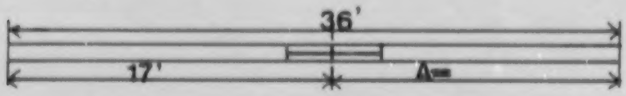
3. A bricklayer contracted a job for $1,150. A total of $447 was spent for brick, $92 for mortar and $34 for sand. If labor cost $230, what was the profit?

4. On floor plans the openings in wood frame walls are measured from a given point to the center ($C_L$) of the openings. If the carpenter needs to know the distance from the edge of the opening, he must subtract. Determine the missing dimension "B" in the sketch below.

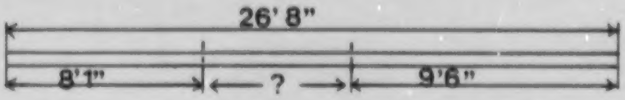


Determine the missing dimensions.

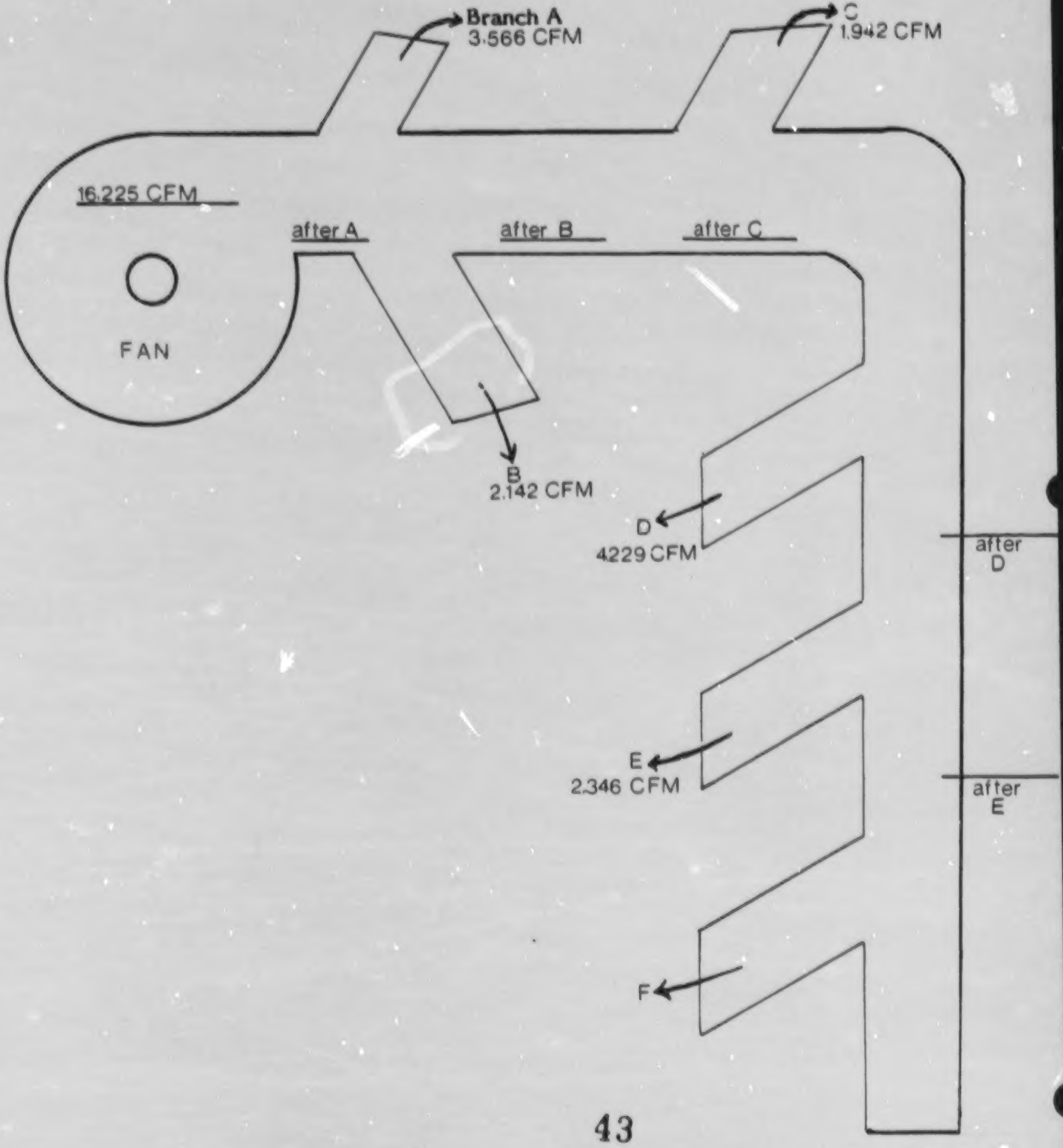
5.



6.



7. An air conditioning duct system has 16,225 cubic feet per minute (CFM) of air entering the main duct from the fan. A quantity of air leaves the main duct at each branch duct. Determine the quantity of air remaining after each branch duct. Record answers in the space provided on the drawing.


Branch A
3.566 CFM
C
1.942 CFM
16.225 CFM
after A
after B
after C
FAN
B
2.142 CFM
D
4229 CFM
after D
E
2.346 CFM
after E
F

## APPLIED VOCATIONAL MATHEMATICS

### COMPETENCY

Solve problems that require computations with whole numbers.
Use a calculator to solve problems.

### PERFORMANCE OBJECTIVE #7

Given a calculator, solve application problems that require multiplying whole numbers.

### SAMPLE ITEM

A good mason can lay about 300 blocks per day. At this rate, how many would a mason lay in 5 days? (ans: 1,500 blocks)

### NOTES

Practice in multiplying whole numbers should involve more than solving a problem when two numbers are given -- 80 x 4 = 320. In the air conditioning trade many data sheets are used to record vital information and then solve problems. One such sheet is the Heating Data Sheet which requires the student to choose the numbers to be multiplied and then record the answer in the proper place.

### REFERENCE TO TEXT

Applied General Mathematics (AGM), pages 21 - 32

### EVALUATION

1. A parts delivery van travels at 86 kilometers per hour. How far has it gone after 3 hours?

2. A roll of wire weighs 20 kilograms. This type wire contains 348 meters of wire per kilogram. What is the total length of wire on the roll?

3. If a car has a 19-gallon tank and averages 16 miles to a gallon, how far can it travel on one tank of gas?

4. If one ream of stock weighs 18 pounds, how much do 42 reams weigh?

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## ANSWERS TO EVALUATION

1. 258 km
2. 6,960 m
3. 304 miles
4. 756 pounds

## ANSWERS TO APPLICATIONS

1. $2,363
2. $1,520
3. $132
4.

### HEATING DATA SHEET

DATE

BY

OUTSIDE DESIGN TEMP -2°F

HEATING CONTRACTOR

INSIDE DESIGN TEMP 70°F

NAME OF JOB

DESIGN TEMP DIFF 72°F.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Room Use and Floor Level | | | | 1. L.R | | 2. B R #1 | | 3. B R #2 | | 4 D.R | |
| 2. Room Length and Width | | | | 18 x 16 | | 12 x 13 | | 14 x 13 | | 10 x 14 | |
| 3. Running Ft of Exposed Wall | | | | 34 | | 12 | | 27 | | 24 | |
| 4. Ceiling Height | | | | 8 | | 8 | | 8 | | 8 | |
| 5. Exposure Type | Table No. | "U" Factor | Multiplier | Area Crack Cfm | Btuh Loss | Area Crack Cfm | Btuh Loss | Area Crack Cfm | Btuh Loss | Area Crack Cfm | Btuh Loss |
| 6. Gross Exposed Wall | | | | 272 | | 96 | | 216 | | 192 | |
| 7. Windows and Doors W | | | 40 | 79 | 3160 | 18 | 720 | 18 | 720 | 36 | 1440 |
| D. | | | 22 | 21 | 462 | | | | | | |
| 8. Net Exposed Wall | | | 10 | 211 | 2110 | 78 | 780 | 198 | 1980 | 156 | 1560 |
| 9. Cold Partition | | | | | | | | | | | |
| 10. Cold Ceiling | | | 7 | 288 | 2016 | 156 | 1092 | 182 | 1274 | 140 | 980 |
| 11. Cold Floor | | | 10 | 288 | 2880 | 156 | 1560 | 182 | 1820 | 140 | 1400 |
| 12. Infiltration, (Leakage) or Air Change | | | 42 | 18 | 756 | 12 | 504 | 12 | 504 | 18 | 756 |
| | | | 70 | 21 | 1470 | | | | | | |
| 13. Room Sub-Total Btuh | | | | 12,854 | | 4656 | | 6298 | | 6136 | |
| 14. Btuh Adjustment | | | | | | | | | | | |
| 15. Room Total Btuh | | | | | | | | | | | |
| 16. Cfm @ Temp. Rise | | | | | | | | | | | |
| 17. Adjusted cfm | | | | | | | | | | | |

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# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #7

Performance Objective #7: Given a calculator, solve application problems that require multiplying whole numbers.

1. Find the cost of 17,000 brick at $139 per thousand.

2. Figure the total amount of a mason contractor's weekly payroll for 5 bricklayers who work 38 hours each at $8.00 per hour.

3. Find the cost of 11 tons of sand at $12 per ton.

4. Given a Heating Data Sheet with all necessary data recorded, determine the BTUH loss for the L.R., BR #1, BR #2 and D.R. by multiplying the AREA CRACK CFM by the MULTIPLIER. Record your answers in the BTUH column under each room.

**HEATING DATA SHEET**

DATE ______ BY ______
OUTSIDE DESIGN TEMP -2 F
INSIDE DESIGN TEMP 70°F
DESIGN TEMP DIFF 72°F
HEATING CONTRACTOR ______
NAME OF JOB ______

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Room Use and Floor Level | | | | 1. L. R | | 2. B R #1 | | 3. B R #2 | | 4. D R | |
| 2. Room Length and Width | | | | 18 x 16 | | 12 X 13 | | 14 x 13 | | 10 x 14 | |
| 3. Running Ft of Exposed Wall | | | | 34 | | 12 | | 27 | | 24 | |
| 4. Ceiling Height | | | | 8 | | 8 | | 8 | | 8 | |
| 5. Exposure Type | Table No. | "U" Factor | Multiplier | Area Crack Cfm | Btuh Loss | Area Crack Cfm | Btuh Loss | Area Crack Cfm | Btuh Loss | Area Crack Cfm | Btuh Loss |
| 6. Gross Exposed Wall | | | | 272 | | 96 | | 216 | | 192 | |
| 7. Windows and Doors | | | 40 | 79 | | 18 | | 18 | | 36 | |
| | | | 22 | 21 | | | | | | | |
| 8. Net Exposed Wall | | | 10 | 211 | | 78 | | 198 | | 156 | |
| 9. Cold Partition | | | | | | | | | | | |
| 10. Cold Ceiling | | | 7 | 288 | | 156 | | 182 | | 140 | |
| 11. Cold Floor | | | 10 | 288 | | 156 | | 182 | | 140 | |
| 12. Infiltration, (Leakage) or Air Change | | | 42 | 18 | | 12 | | 12 | | 18 | |
| | | | 70 | 21 | | | | | | | |
| 13. Room Sub-Total Btuh | | | | | | | | | | | |
| 14. Btuh Adjustment | | | | | | | | | | | |
| 15. Room Total Btuh | | | | | | | | | | | |
| 16. Cfm @ Temp. Rise | | | | | | | | | | | |
| 17. Adjusted cfm | | | | | | | | | | | |

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# linear measurement

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCIES

Solve problems that require computations with whole numbers.
Use a calculator to solve problems.

## PERFORMANCE OBJECTIVE #8

Given a calculator, solve application problems that require dividing whole numbers.

## SAMPLE ITEM

A paper cutter operator cuts 4 equal lengths from a sheet measuring 36 inches. What is the length of each piece? (Ans. 9")

## NOTES

**Air Conditioning/Refrigeration:** Data sheets are required to record information and then solve problems. Calculating heat loads on buildings is a good example. This form provides good practice in dividing whole numbers.

## REFERENCE TO TEXT

**Applied General Mathematics** (AGM), pages 33-42

## EVALUATION

1. A warehouse receives 38,000 transistor pockets. They are divided equally into 16 storage bins. How many are in each bin?
2. A total load of 15,840 watts is distributed equally over 12 circuits. What is the load per circuit in watts?
3. If 168,424 pieces are machined in 8 hours, how many are machined per hour?
4. How many rafters 42 inches long can be cut from a piece of lumber 168 inches long? (Do not allow for saw kerfs.)

## ANSWERS TO EVALUATION

1. 2,375 sockets
2. 1,320 watts
3. 21,053 pieces
4. 4 rafters

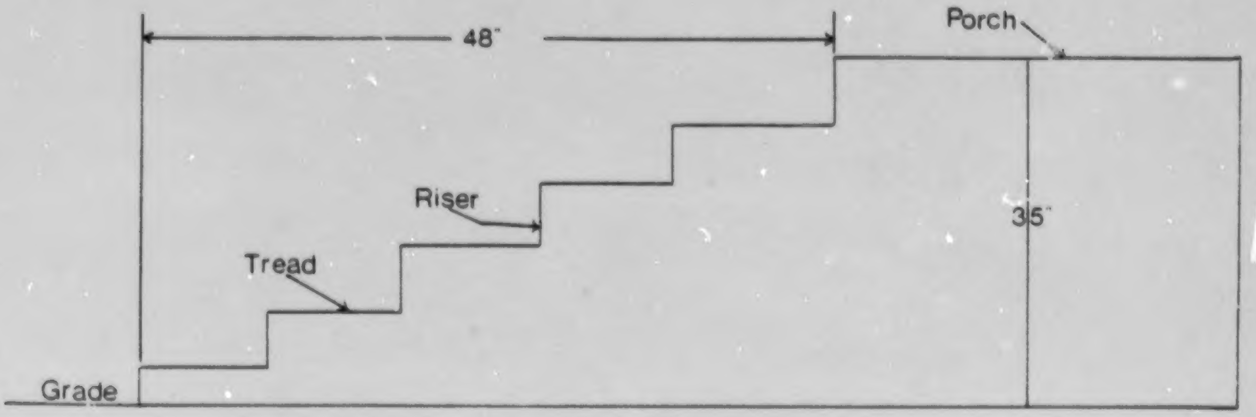
## ANSWERS TO APPLICATIONS

1. 7"
2. 9½"
3. 42 sheets

| | | | |
|---|---|---|---|
| 4. | Windows | | 79 |
| | Doors | | 22 |
| | Net Wall | | 10 |
| | Ceiling | | 7 |
| | Floor | | 10 |
| | Infiltration | W: | 42 |
| | | D: | 70 |

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #8

Performance Objective #8: Given a calculator, solve application problems that require dividing whole numbers.



1. Using the above drawing, what is the height of each riser?

2. What is the width of each tread?

3. If each 4' x 8' plywood sheet contains 32 square feet, how many sheets would be needed to floor 1,344 square feet?

4. The worksheet below is used to make heat load calculations. Determine the HTF (Heat Transfer Factor) by dividing the BTUH (British Thermal Unit) loss by the area. Record the HTF in the column provided.

| | | AREA | HTF | BTUH LOSS |
|---|---|---|---|---|
| GROSS WALL | | 1,248 | | |
| WINDOWS | | 158 | | 12,482 |
| DOORS | | 42 | | 924 |
| NET WALL | | 1,048 | | 10,480 |
| CEILING | | 1,440 | | 10,080 |
| FLOOR | | 1,440 | | 14,400 |
| | | Crackage | | |
| INFILTRATION | W | 47 lin. ft. | | 1,974 |
| | D | 21 lin. ft. | | 1,470 |
| TOTAL LOSS | | | | 51,810 |

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Read a customary unit ruler.

## PERFORMANCE OBJECTIVE #9

Given a line segment and a ruler, measure the length of the segment to the nearest sixteenth of an inch.

## SAMPLE ITEM

Measure the length of this segment to the nearest sixteenth of an inch.

## NOTES

**Construction:** Most construction work is measured to the nearest sixteenth of an inch.

**Machine Shop:** A machinist must become adept at measuring with a rule to rough out parts quickly on the machines as well as to lay out parts accurately before machining if the degree of accuracy warrants. Practice in developing skills in measuring may be obtained by measuring lengths of lines on scale drawings of sheet metal patterns.

**General:** Supply students with several different types of rulers. After students understand the increments of the ruler, give them many opportunities to measure actual objects, not just line segments on paper. Be sure students understand the notation ' = feet and " = inches.

**Welding:** The steel tape measure is used to measure various lengths of steel in inches and fractional parts of inches.

## EVALUATION

Measure these segments to the nearest sixteenth of an inch.

1.

2.

3.

4.

## ANSWERS TO EVALUATION

1. 3 1/16"
2. 8/16"
3. 5 2/16"
4. 2 5/16"

## ANSWERS TO APPLICATIONS

1. a) 3/4"
   b) 2 2/4" or 2 1/2"
   c) 7/8"
   d) 2 3/8"
   e) 4 1/8"
   f) 9/16"
   g) 2 1/16"
   h) 4 9/16"

2. a) 3 7/8"
   b) 4 11/16"
   c) 4 32/64" or 4 1/2"
   d) 2 46/64" or 2 23/32"

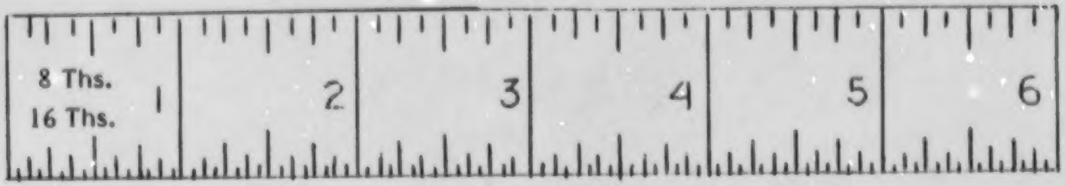
3. a) 6/16" or 3/8"
   b) 11/16"
   c) 1 2/16" or 1 1/8"
   d) 1 10/16" or 1 5/8"
   e) 2 2/16" or 2 1/8"
   f) 3 1/16"
   g) 3 12/16" or 3 3/4"
   h) 4 15/16"

4. a) 2 15/16"
   b) 4 1/4"
   c) 3 3/4"
   d) 2 5/16'
   e) 3 3/16'

5. AJ = 1 15/16"
   AC = 2 1/2"
   AH = 1"
   CF = 1"
   JK = 1 1/16"
   JF = 2 11/16"

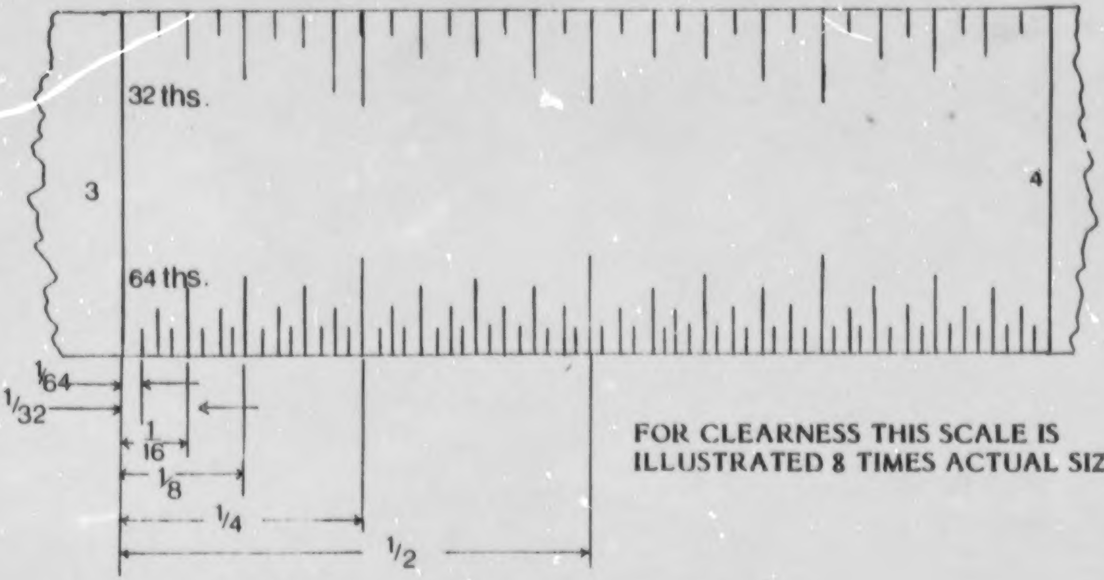
Note: Answers may vary due to measuring instruments or alterations occurring during printing.

## 6" STEEL SCALE



8 Ths.
16 Ths.
1
2
3
4
5
6

SCALE 1" = 1"



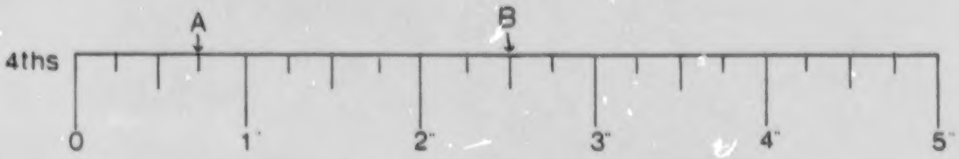
32 ths.
3
4
64 ths.
1/64
1/32
1/16
1/8
1/4
1/2

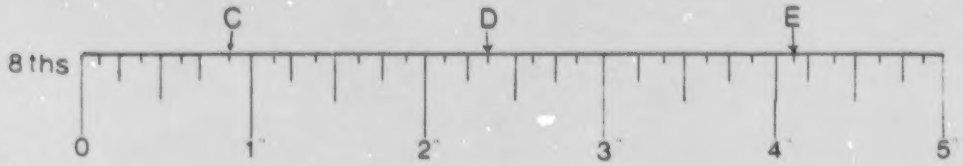
FOR CLEARNESS THIS SCALE IS
ILLUSTRATED 8 TIMES ACTUAL SIZE.

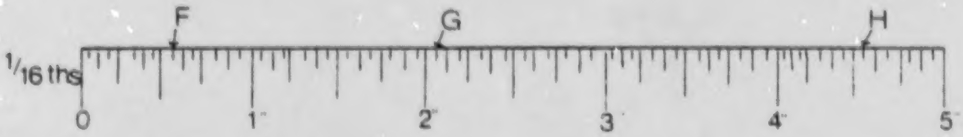
# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #9

Performance Objective #9: Given a line segment and a ruler, measure the length of the segment to the nearest sixteenth of an inch.

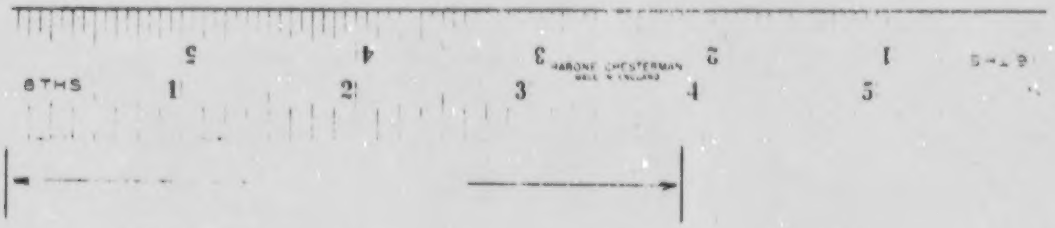
1. Read the distance from the start of the steel tape measure to the letters on the tape measure.

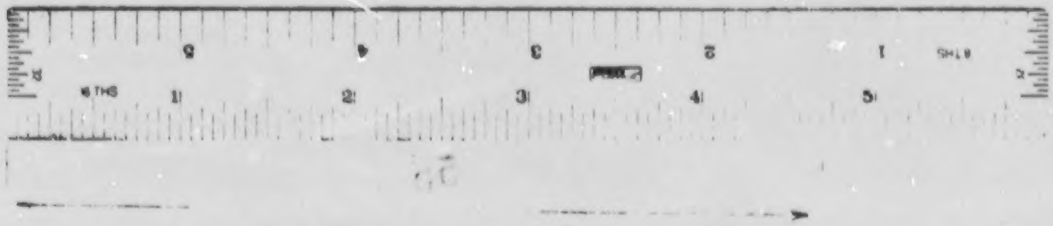

A
B
4ths
0
1"
2"
3"
4"
5"


C
D
E
8 ths
0
1"
2"
3"
4"
5"

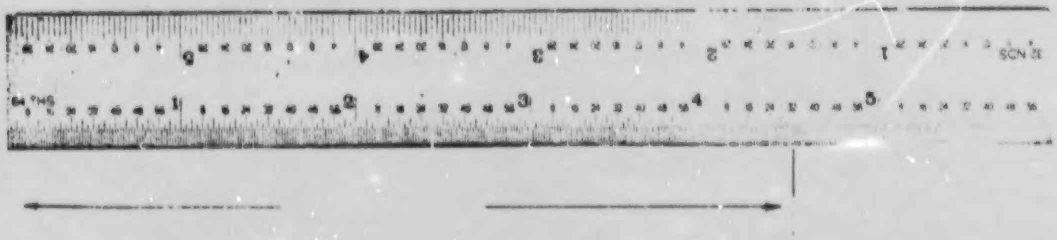

F
G
H
1/16 ths
0
1"
2"
3"
4"
5"

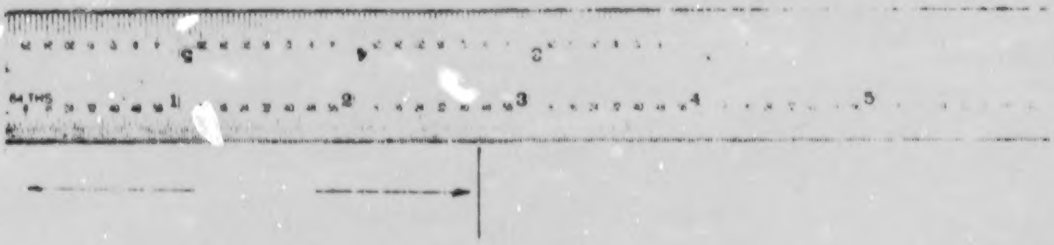
2. What is the length indicated on each of these machine shop rules?



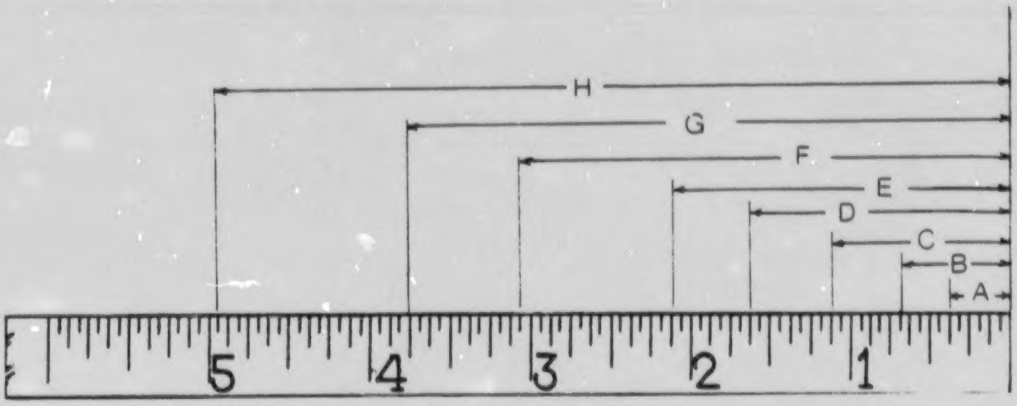

16THS
1
2
3
4
5

BEST COPY AVAILABLE


64THS
1
2
3
4
5

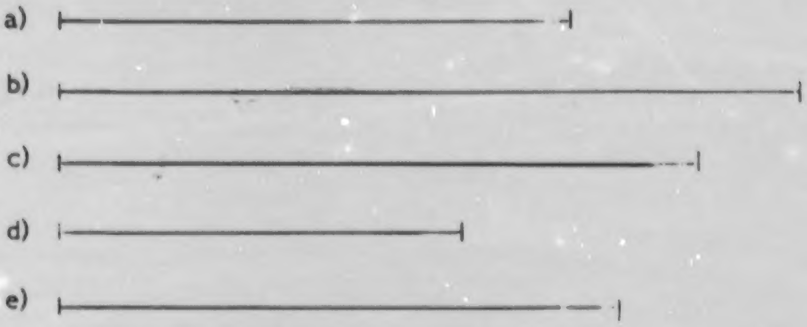

64THS
1
2
3
4
5

3. Below is a portion of a rule used by masons. You are to write, in figures, the inches and fractional parts of an inch that are represented by the dimensions lettered "A" to "H," inclusive.


H
G
F
E
D
C
B
A
5
4
3
2
1

BEST COPY AVAILABLE

4. Using a bench ruler such as a carpenter would use, measure the following lines to the nearest sixteenth of an inch.



5. Sheet metal patterns are used to assist in laying out fittings. The patterns are not dimensioned so they can be used to make any size fitting.

On the given sheet metal patterns, lengths of lines are identified by letters, for example, AH or AB. Measure the lines indicated below and record the length to the nearest sixteenth of an inch.

AJ = ___________

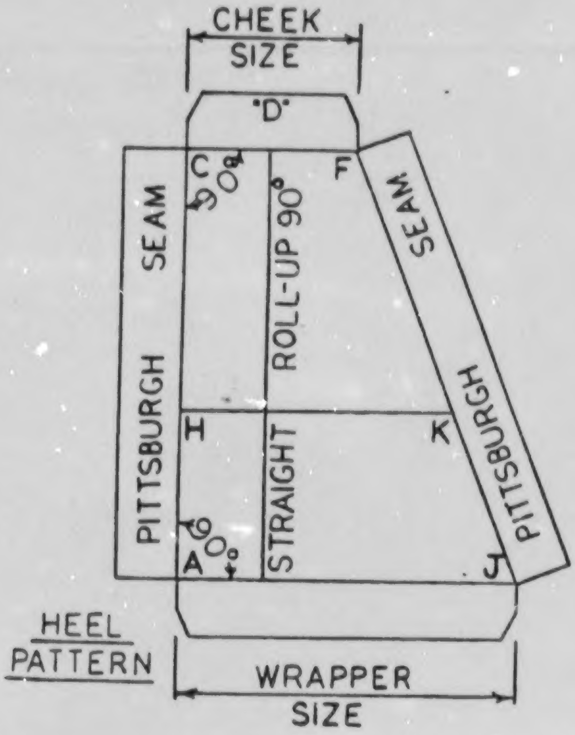
AC = ___________

AH = ___________

CF = ___________

JK = ___________

JF = ___________


CHEEK SIZE
"D"
C
90°
F
SEAM
ROLL-UP 90°
SEAM
PITTSBURGH
H
K
STRAIGHT
PITTSBURGH
A
90°
J
HEEL PATTERN
WRAPPER SIZE

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

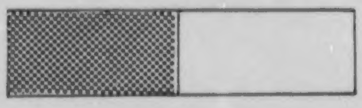
Explain the meaning of common fractions.

## PERFORMANCE OBJECTIVE #10

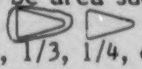
Given a common fraction, draw a pictorial representation.

## SAMPLE ITEM

Draw a pictorial representation of 1/2.



## NOTES

**General:** Students frequently have difficulty with fractions because they do not understand the meaning of fractions. Stress this understanding by reading fractions in different ways and by drawing them in different ways. For example, 1/2 may be explained as for every girl there will be 2 boys, or one part oil for 2 parts gas. Pictures can be area such as in the sample above or distance (such as a ruler) or pieces such as . (This could be read one out of two.) Stress unit fractions first (1/2, 1/3, 1/4, etc.), then fractions equal to a whole (2/2, 3/3, 4/4, etc.) Use manipulatives as much as possible.

When doing any type of fabrication, understanding of fractional parts is essential. One must be able to visualize the part of the whole. Practice is needed in dividing actual items or things.

**Welding:** Standard sheet metal and sheet steel when ordered come in 4' x 8' sheets.

Ex. 1/4" x 4' x 8' = 1/4" thickness, 4' wide, 8' long

## REFERENCE TO TEXT

**Applied General Mathematics** (AGM), pages 51-54

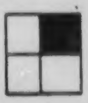
## EVALUATION

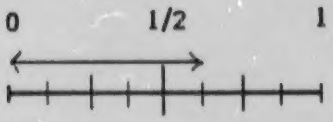
Draw pictorial representations for each of the following fractions.

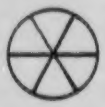
1. 1/4
2. 5/8
3. 6/6
4. 3/4

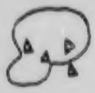
## ANSWERS TO EVALUATION

Note: Drawings will vary. The drawings below are just examples.

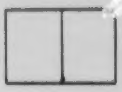
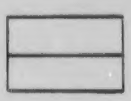
1. 

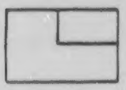
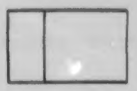
2. 

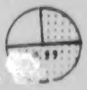
3. 

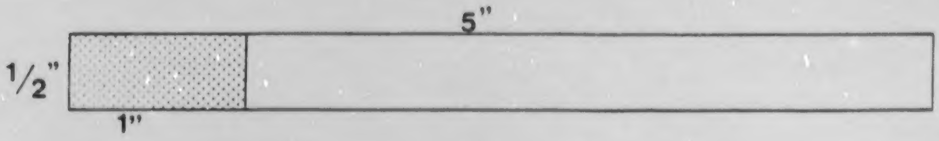
4. 

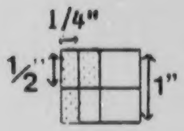
## ANSWERS TO APPLICATIONS

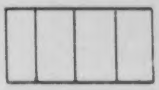
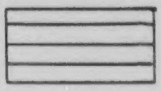
1.  or 

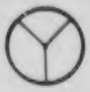
2.  or 

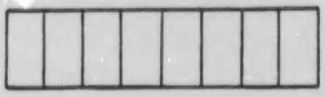
3. a) 

b) 

c) 

4.  or 

5. 

6. 

## APPLICATIONS
## FOR
## PERFORMANCE OBJECTIVE #10

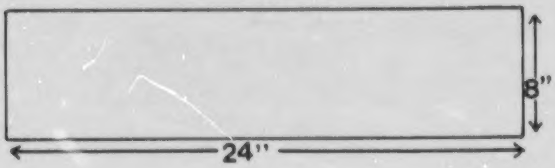
Performance Objective #10: Given a common fraction, draw a pictorial representation.

1. On the sheet of steel below draw a cut line for the welder to cut the sheet in half.

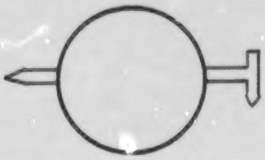
2. On the sheet of steel below draw a cut line for the welder to cut 1/4 of the sheet out.

3. Draw pictorial representations as required.
   a) A 1" diameter circle with 3/4 of it shaded.
   b) A 1/2" x 5" rectangle with 1/5 shaded.
   c) A 1 inch square with 3/8 shaded.

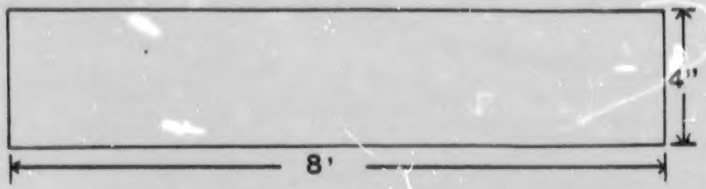
4. Given a rectangular piece of copper 8" x 24", divide the piece into one-fourths (1/4) by drawing dashed lines.



5. Given a sheet metal damper 6 inches in diameter, divide it into one-thirds (1/3) by drawing dashed lines.



6. A 4-inch diameter plastic pipe is 8 ft. long. Divide the pipe into one-eights (1/8) by drawing dashed lines.



61

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Compare fractions.

## PERFORMANCE OBJECTIVE #11

Given two common fractions, tell which is larger or state that they are equivalent.

## SAMPLE ITEM

Replace the question mark with < (less than), > (greater than) or = (equal to).

3/16 ? 1/8 (ans. >)

## NOTES

**General:** Students typically compare fractions by cross-multiplying or getting common denominators. Another method is to compare lengths on a ruler when appropriate denominators are used.

Help students learn the general rules for comparing fractions with like numerators as well as like denominators. If the numerators are the same, the fraction with the larger denominator is smaller because the whole has been divided into more (and therefore, smaller) pieces.

Screws, nuts, bolts, rods, pipe and tubing are used in most trade areas. These items are identified by fractional size. Students must be able to compare correctly various fractional sizes.

## REFERENCE TO TEXT

Applied General Mathematics (AGM), pages 69-70

## EVALUATION

Replace the ? with <, > or =.

1. 5/32 ? 11/16
2. 1/2 ? 3/8
3. 3/4 ? 12/16
4. 6/8 ? 11/16

## ANSWERS TO EVALUATION

1. <
2. >
3. =
4. >

## ANSWERS TO APPLICATIONS

1. a) < b) > c) =
2. a) 9/16
   b) 3/10
   c) 13/24
   d) 7/12
   e) 1/16
   f) 4/16
3. 1/4
4. a) no
   b) 5/8
5. 1/8"

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #11

Performance Objective # 11: Given two common fractions, tell which is larger or state that they are equivalent.

1. Place the appropriate symbol (>, <, =) between the following fractions.

   a) 2/3 ? 3/4
   b) 3/5 ? 4/7
   c) 3/5 ? 21/35

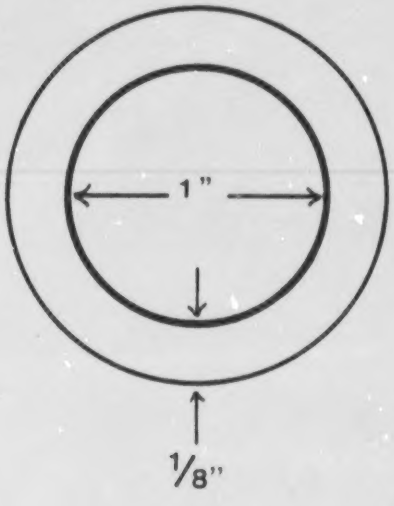
2. Determine the smaller fraction.

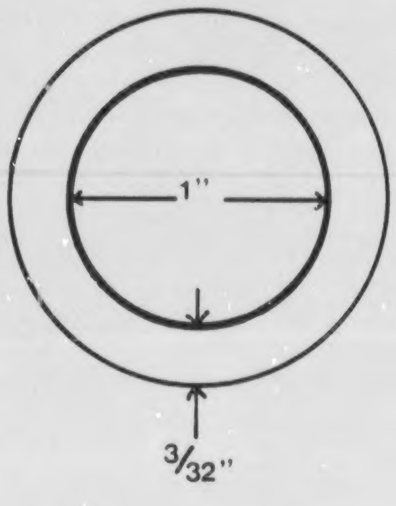
   a) 3/4 or 9/16
   b) 3/10 or 12/30
   c) 7/12 or 13/24
   d) 7/12 or 10/16
   e) 1/16 or 1/8
   f) 4/15 or 4/16

3. Nut drivers are used to loosen and tighten hex head screws. Two nut drivers are available: 3/16 and 1/4. Which one is the larger?

4. Copper tubing is measured by outside diameter (O.D.) when used in refrigeration work. There is a need for 1/2" O.D. copper tubing. Tubing available is 1/4, 3/8, 5/16, and 5/8.
   a) Is 1/2" O.D. available?
   b) Of the tubing available, which is larger than 1/2"?

5. Two pipes have the same inside diameter but the wall thickness is different. Which pipe has the thickest walls? Drawings are not to scale.





# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Give equivalent fractions.

## PERFORMANCE OBJECTIVE #12

Given a common fraction and a new denominator, write an equivalent fraction.

## SAMPLE ITEM

3/4 = ?/8 (ans. 6)

## NOTES

Comparison of different sizes of nuts, bolts, screws, washers, pipe and tubing is necessary when doing installation and service work. Students should be able to convert from one denominator to another denominator.

Manipulatives such as egg cartons help in visualizing equivalent fractions.

## RESOURCES

**Applied General Mathematics** (AGM), pages 54-65

## EVALUATION

Replace the ? with a number to make an equivalent fraction.

1. 3/5 = ?/10
2. 5/8 = ?/16
3. 10/16 = ?/8
4. 6/8 = ?/4

## ANSWERS TO EVALUATION

1. 6
2. 10
3. 5
4. 3

## ANSWERS TO APPLICATIONS

1. a) 1/2
   b) 4/2
   c) 1/2
   d) 8/2

2. a) 4/8
   b) 28/8
   c) 2/8
   d) 2/8

3. a) 24/64
   b) 30/64
   c) 28/64
   d) 12/64

4. a) 1/2
   b) 1/2
   c) 5/8
   d) 9/64
   e) 3/8
   f) 1/8

5. a) 1/8 = 4/32
   b) 1/2 = 16/32
   c) 3/16 = 6/32
   d) 1/4 = 8/32
   e) 5/8 = 20/32
   f) 5/16 = 10/32

6. a) no
   b) 5/16 = 20/64
   c) 1/4 = 16/64

7. 12/16

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #12

Performance Objective #12: Given a common fraction and a new denominator, write an equivalent fraction.

1. Reduce to halves.

   a) 2/4
   b) 16/8
   c) 4/8
   d) 32/8

2. Change to eighths.

   a) 1/2
   b) 7/2
   c) 1/4
   d) 4/16

3. Change to sixty-fourths.

   a) 3/8
   b) 15/32
   c) 7/16
   d) 24/128

4. Reduce to lowest terms.

   a) 4/8
   b) 5/10
   c) 10/16
   d) 9/64
   e) 12/32
   f) 8/64

5. Bin labels are being prepared for a large selection of washers. To be sure that the labels are applied to the bins in an increasing order (smallest to largest), it is necessary to change all washer sizes to a common denominator. Write each fraction with a denominator of 32.

   a) 1/8
   b) 1/2
   c) 3/16
   d) 1/4
   e) 5/8
   f) 5/16

6. A 5/16" bolt and a 1/4" nut are to be used to clamp two pieces of metal together.
   a) Will the two screw together?

   Prove by changing both fractions to new fractions with denominators of 64.
   b) 5/16
   c) 1/4

7. A piece of metal is 3/4" thick. How would this thickness be identified with a denominator of 16?

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Add, subtract, multiply and divide fractions.

## PERFORMANCE OBJECTIVE #13

Given any combination of fractions, mixed numbers and whole numbers, find the sum.

## SAMPLE ITEM

Add: 2 3/4 + 1 7/8 (ans. 4 5/8)

## NOTES

Calculating the length of material (wood, pipe, wire, etc.) needed to fabricate items or install equipment is of importance in the shop. Seldom are all measurements whole numbers, so the addition of whole numbers, fractions and mixed numbers will be the rule.

Masons and carpenters use fractions extensively, especially with denominators of 2, 4, 8, 16 and 32.

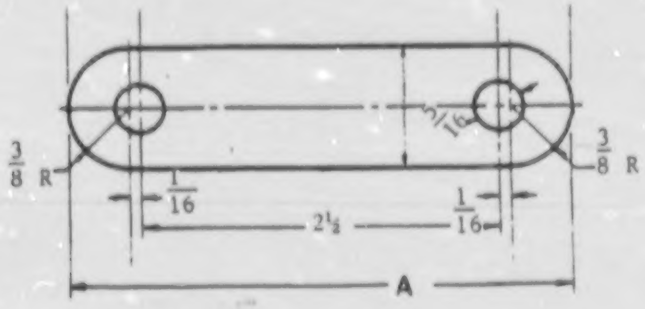
## REFERENCE TO TEXT

**Applied General Mathematics** (AGM), pages 70 - 78

## EVALUATION

1. What will be the length of a piece of 2 x 4 lumber needed to cut the following pieces. Allow 1 1/2" for waste and kerfs. One piece is 3/4" long, one piece is 1 5/8" long, one piece is 15" long and one piece is 14 1/2" long.

2. Find the length of A on the sketch of link shown below.



3. For a job a mason estimates that the following amounts of mortar are needed.

   a) 20 1/2 cubic yards
   b) 8 2/3 cubic yards
   c) 11 1/4 cubic yards
   How many cubic yards are needed altogether?

4. What is the total thickness of a wall having 7/8 inch finish siding, 7/8 inch rough siding, 3 3/4 inch studs, and 13/16 inch of lath and plaster?

## ANSWERS TO EVALUATION

1. 33 3/8"
2. 3 3/8"
3. 40 5/12 cubic yards
4. 6 5/16"

## ANSWERS TO APPLICATIONS

1. 9 3/4 hours
2. 4 15/16"
3. 29 square yards
4. 57 15/16"
5. 17 1/8"
6. 16" x 10 3/4"
7. 7 5/32"
8. 161 5/8"
9. a) 13 1/4"
   b) 8 1/2"
10. 3 1/8"
11. 4 1/8"
12. 23 5/12 cubic yards
13. 3"

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #13

Performance Objective #13: Given any combination of fractions, mixed numbers and whole numbers, find the sum.

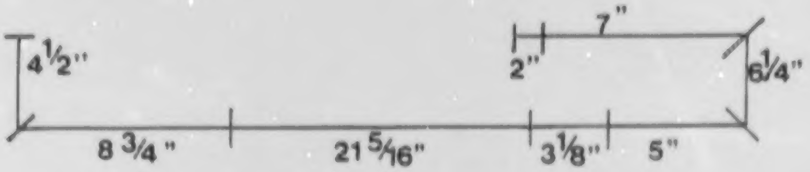
1. A carpenter worked 1/3 hour, 3 3/4 hours, and 5 2/3 hours. How many hours did the carpenter work?

2. What will be the total thickness of a wall allowing for 1/2" sheathing, a 3 1/2" stud and 15/16" lath and plaster?

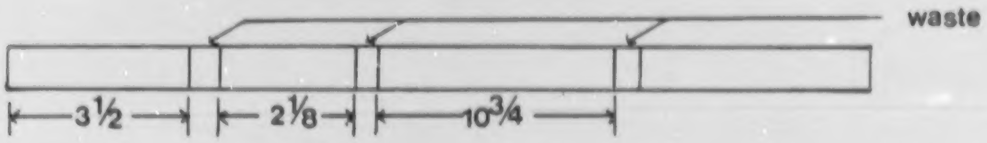
3. A concrete finisher charges by the square yard. What is the total square yardage for these three jobs?

   a) 5 square yards
   b) 6 1/2 square yards
   c) 17 1/2 square yards

4. An assembly is to be made using 1/2" pipe. The length of each piece is given on the sketch. What is the total length of pipe needed? There is no waste when cutting.



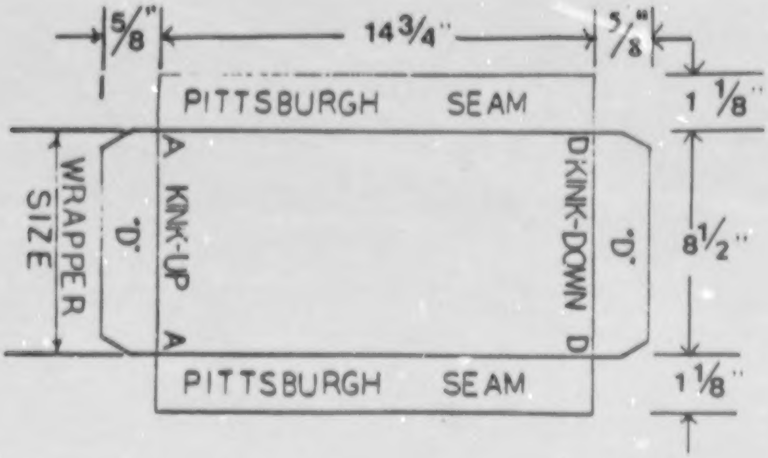
5. A piece of metal is to be cut into smaller pieces using a saw. The amount of waste for each cut is 1/4". What is the length of metal needed to make the size pieces shown on the diagram below?



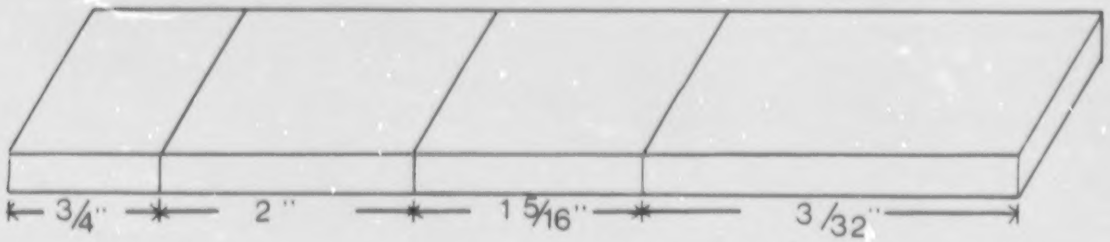
6. The item below is to be made from sheet metal. What size of metal will be required? State size in length and width.

Length ________

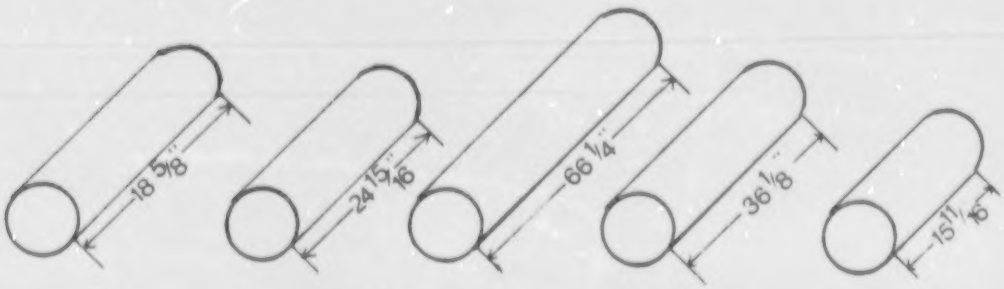
Width ________


5/8"
14 3/4"
5/8"
PITTSBURGH SEAM
1 1/8"
A
KINK-UP
A
"D"
WRAPPER SIZE
D
KINK-DOWN
D
"D"
8 1/2"
PITTSBURGH SEAM
1 1/8"

7. Four pieces of 2 inch cold rolled bar are welded together. What is the total length of the completed weldment?

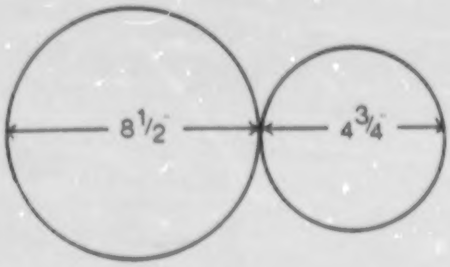

3/4"
2"
1 5/16"
3/32"

8. A weld shop has 5 pieces of 3/4 inch bar stock. When welded together, what will be the total length of the bar?

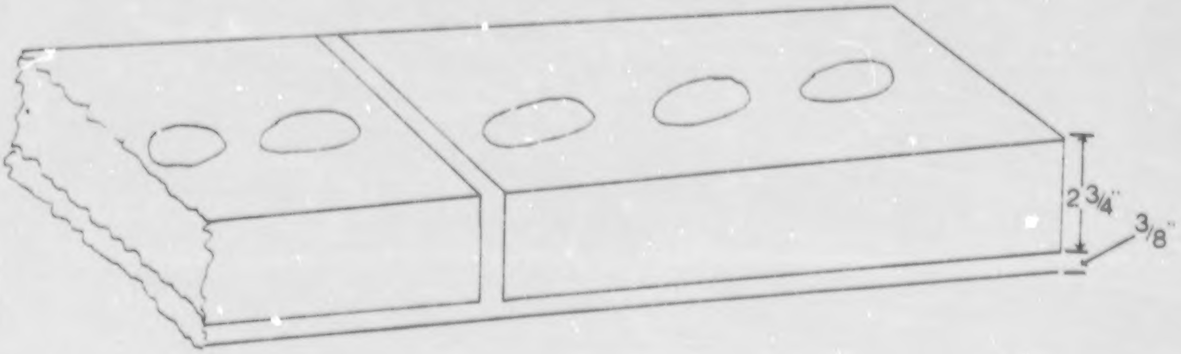

18 5/8"
24 15/16"
66 1/4"
36 1/8"
15 11/16"

9. Two pieces of circular steel must be cut from a sheet of 1/2 inch plate.

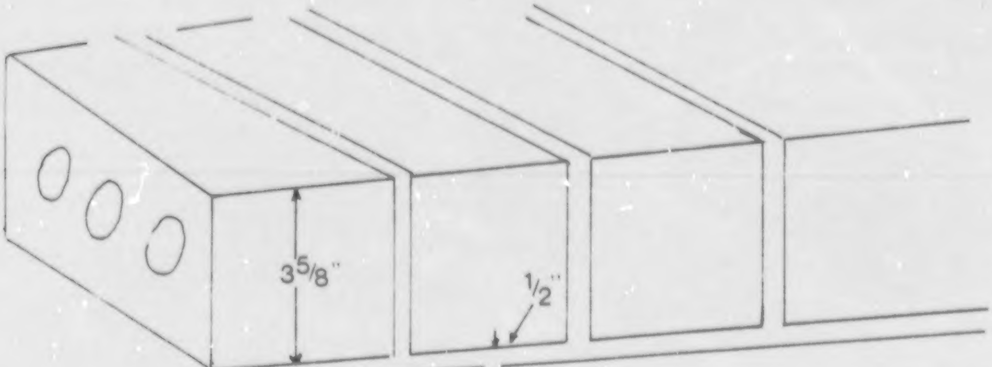
a) What is the length of the plate?
b) What is the width of the plate?



10. Find the height of a stretcher course of brick work if the face of the brick is 2 3/4" high and the motar joint is 3/8" thick.

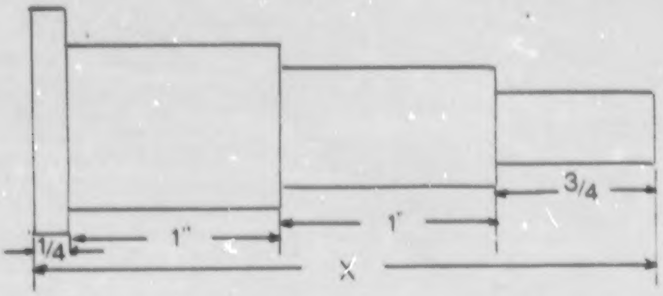


11. Find the height of a rowlock course of brick work if the brick is 3 5/8" high, and the motor joint is 1/2" thick.



12. Three cement finishers poured the following amounts of cement in one day -- 7 2/3 cubic yards, 6 1/4 cubic yards, and 9 1/2 cubic yards. What was the total amount of cement poured by them that day?

13. The student machinest must find the length "X" of the Step Pin given the dimensions below.



# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Add, subtract, multiply and divide fractions.

## PERFORMANCE OBJECTIVE #14

Given any combination of fractions, mixed numbers and whole numbers, find the difference.

## SAMPLE ITEM

A plan for constructing a table top requires boards 1 3/16" thick. The thickness of the boards to be used is 1 1/2". How much must be planed from the boards?

Solution: 1 1/2 – 1 3/16 = (answer: 5/16")

## NOTES

**Carpentry:** In carpentry and wood working, it is often necessary to remove material from stock thickness lumber to achieve the desired thickness. This requires subtracting fractions.

**Welding:** While making a part from a blueprint, a welder often finds it necessary to subtract fractions and mixed numbers to find location of drilled or cut holes and lengths of material.

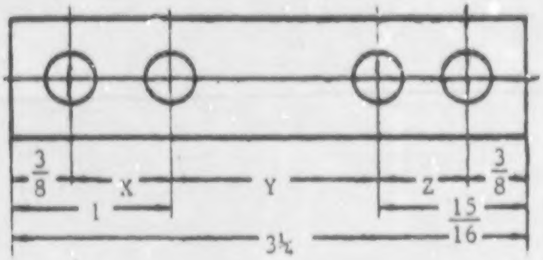
## REFERENCE TO TEXT

**Applied General Mathematics** (AGM), pages 79-89

## EVALUATION

1. An electrician worked 34 1/2 hours last week and 44 3/4 hours this week. How much longer did the electrician work this week?

2. Find dimensions X, Y and Z.



## ANSWERS TO EVALUATION

1. $10 \frac{1}{4}$ hours

2. $X = \frac{5}{8}$; $Y = 1 \frac{5}{16}$; $Z = \frac{9}{16}$

## ANSWERS TO APPLICATION

1. a) $6 \frac{1''}{4}$

   b) $\frac{7''}{8}$

   c) $7 \frac{1''}{8}$

2. a) $13 \frac{3''}{8}$

   b) $9 \frac{1''}{4}$

   c) $4 \frac{1''}{8}$

3. a) $\frac{13''}{16}$

   b) $\frac{15''}{32}$

   c) $\frac{1''}{16}$

4. a) 4'3"

   b) $16' \, 4 \frac{1''}{2}$

   c) 19'3"

5. $\frac{7''}{16}$

6. $1 \frac{31''}{32}$

7. $\frac{5''}{8}$

8. $2\frac{1''}{2}$

9. $3\frac{1}{4}$ sq. yds.

10. $5\frac{7''}{8}$

11. $28\frac{1''}{4}$

12. $4\frac{5''}{16}$

13.
    a) $3\frac{13''}{16}$

    b) $1\frac{1''}{2}$

    c) $1\frac{1''}{2}$

    d) no

    e) Left to right: $\frac{11''}{32}$, $\frac{15''}{32}$, $\frac{3''}{8}$, $\frac{15''}{32}$

    f) Left: $\frac{9''}{32}$ Right: $\frac{5''}{16}$

## APPLICATIONS
## FOR
## PERFORMANCE OBJECTIVE #14

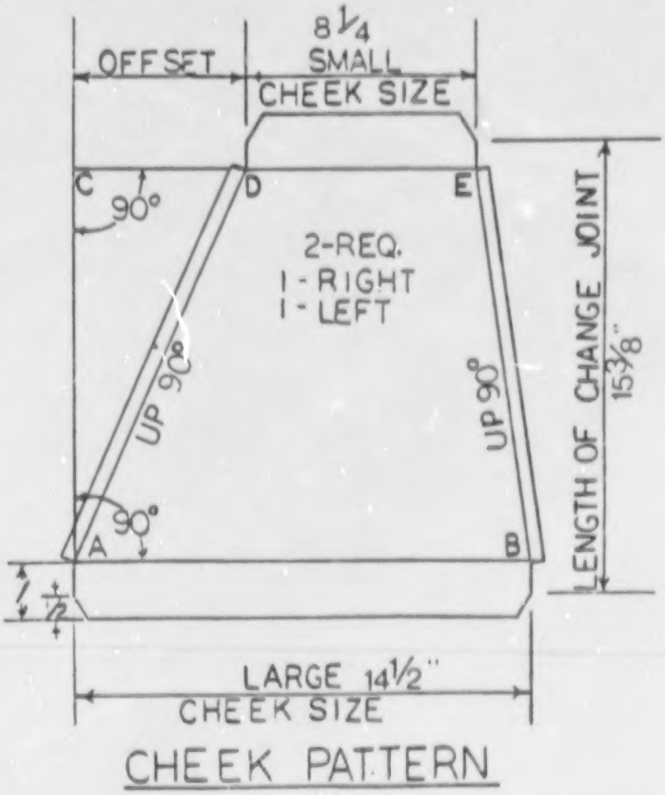
Performance Objective #14: Given any combination of fractions, mixed numbers and whole numbers, find the difference.

1. On the pattern below, determine the difference between the following dimensions. (The sizes are identified by letters, e.g., large cheek size is AB or 14 1/2".)

   a) Difference between AB & DE ___________

   b) Difference between AB & BE ___________

   c) Difference between BE & DE ___________



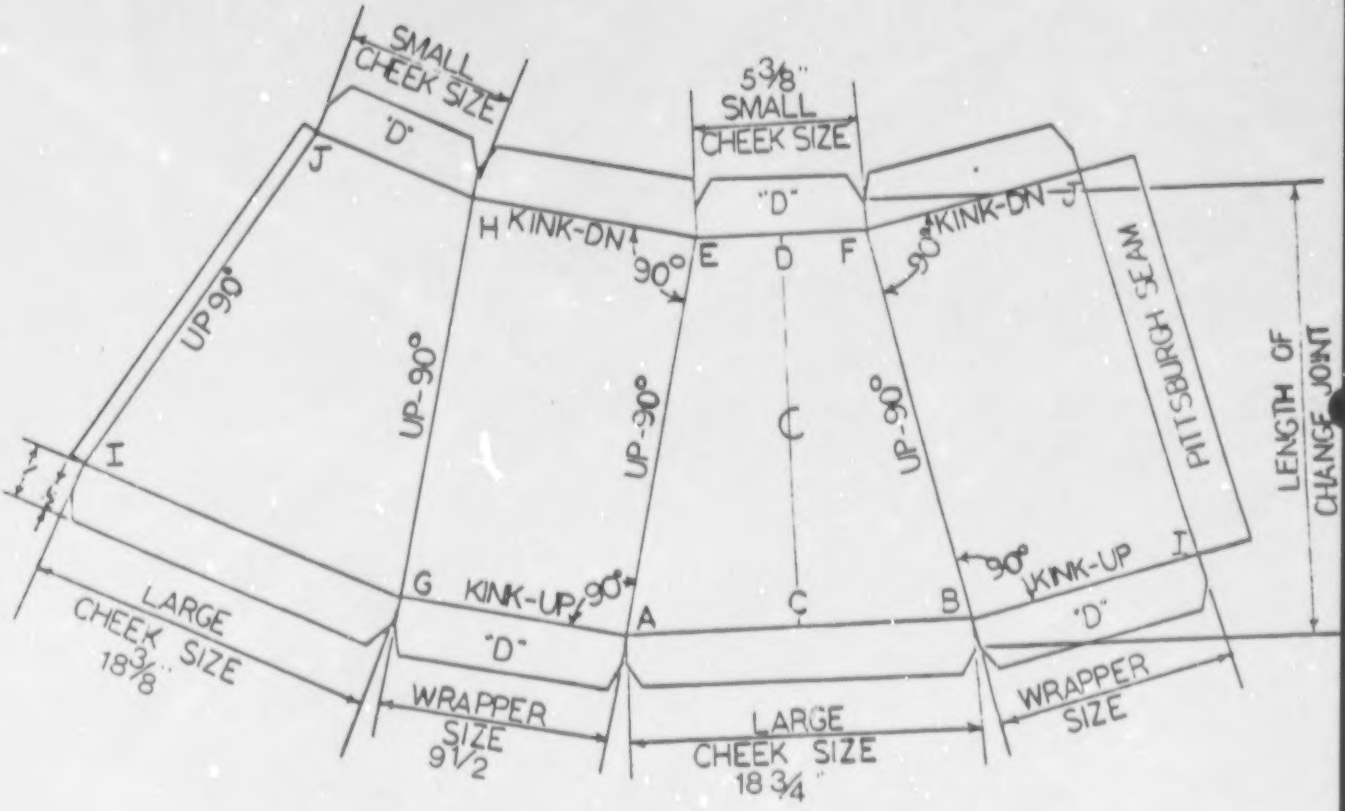
OFFSET
8 1/4
SMALL
CHEEK SIZE
C
D
E
90°
2-REQ.
1-RIGHT
1-LEFT
UP 90°
UP 90°
LENGTH OF CHANGE JOINT
15 3/8"
90°
A
B
1/2
LARGE 14 1/2"
CHEEK SIZE
CHEEK PATTERN

2. On the pattern below, determine the difference between the following dimensions.

a) AB & EF = ___________

b) AB & GA = ___________

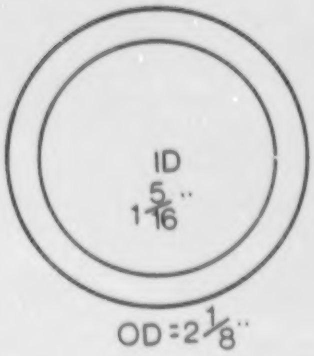
c) GA & EF = ___________



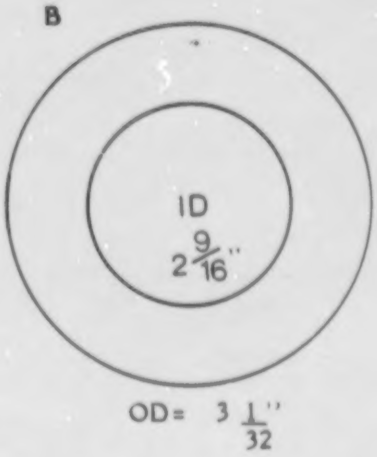
SMALL CHEEK SIZE
"D"
J
UP 90°
I
5 3/8"
SMALL CHEEK SIZE
"D"
H KINK-DN
90°
E
D
F
KINK-DN
J
90°
UP-90°
UP-90°
UP-90°
PITTSBURGH SEAM
LENGTH OF CHANGE JOINT
G KINK-UP
90°
A
C
B
90°
KINK-UP
I
"D"
"D"
LARGE CHEEK SIZE 18 3/8"
WRAPPER SIZE 9 1/2
LARGE CHEEK SIZE 18 3/4"
WRAPPER SIZE

3. Determine the wall thickness of the following pipes. ID is inside diamter. OD is outside diameter.

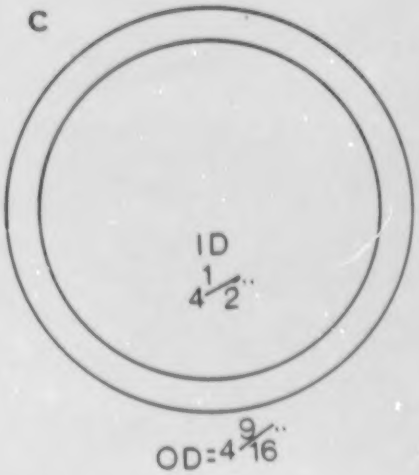
A

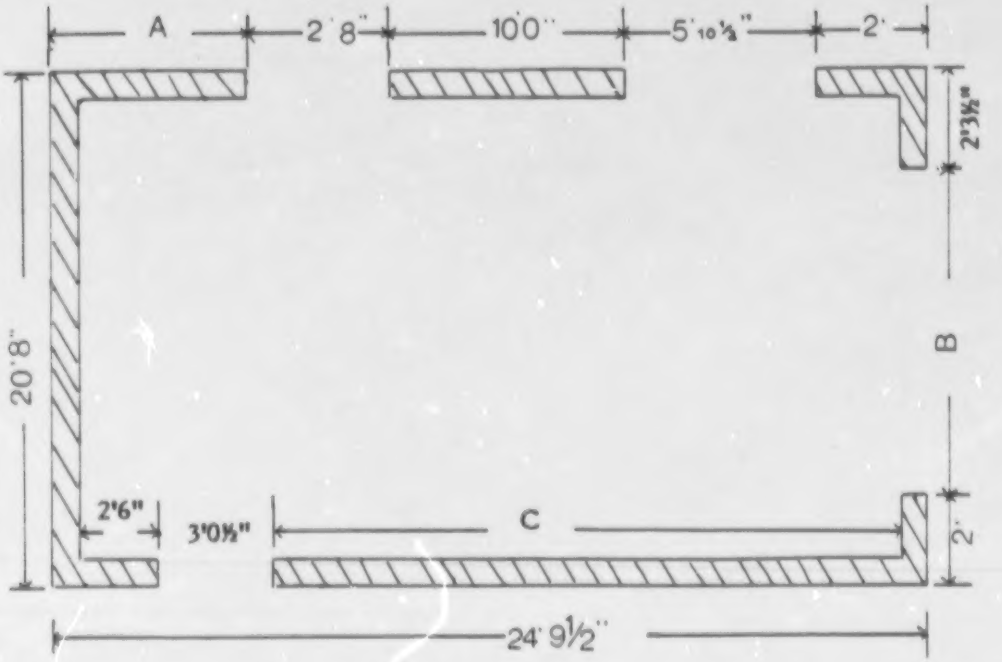

ID
1 5/16"
OD=2 1/8"

B


ID
2 9/16"
OD= 3 1/32"

C


ID
4 1/2"
OD=4 9/16"


A
2'8"
10'0"
5'10½"
2'
2'3½"
B
2'
20'8"
2'6"
3'0½"
C
24'9½"

4. Using the above blueprint of a block garage, find these dimensions.

A =
B =
C =

5. Find the thickness of a rough board 1/2 inch thick after 1/16 inch is taken off by planing on one side.

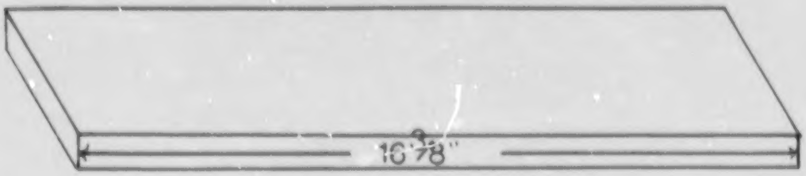
6. The total thickness of a counter top is 2 1/16 inches after being covered with 3/32 inch rigid plastic. What is the thickness of the top before covering?

7. The thickness of a piece of three-ply wood is 3/4 inch. It was made by gluing 1/16 inch pieces on both faces. What is the thickness of the original piece?

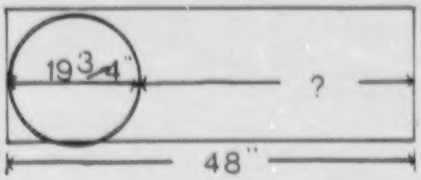
8. Subtract 1 1/2 in. from 4 in.

9. Subtract 9 1/4 square yards from 12 1/2 square yards.

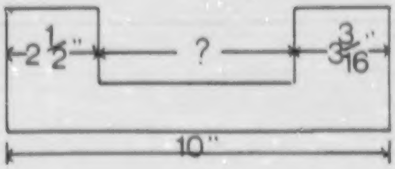
10. A 10 1/2" long piece of bar stock is cut from this piece. How much of the bar stock is left?

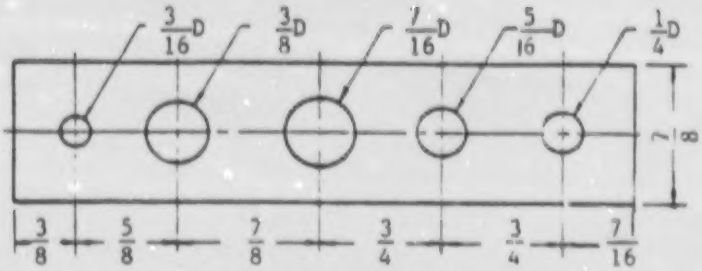


11. A 19 3/4" diameter circle is cut from this plate. Find the missing dimension.



12. A piece of steel is to be flame cut to the shape shown. Find the missing dimension.





13. In the part shown above:

a) Find the overall length.

b) Find the distance from the center of the 3/16" hole to the center of the 7/16" hole.

c) Find the distance from the center of the 1/4" hole to the center of the 7/16" hole.

d) Is the 7/16 hole in the center of the overall length?

e) Calculate the wall thickness between each of the holes.

f) What is the wall thickness between each hole and the long edge of the part?

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Add, subtract, multiply and divide fractions.

## PERFORMANCE OBJECTIVE #15

Given any combination of fractions, mixed numbers and whole numbers, find the product.

## SAMPLE ITEM

In determining the allowance made for the plumb cut of a rafter, one must allow one-half of the thickness of the ridge itself. Find the allowance when the ridge is 1 1/2" thick.
Solution: 1/2" x 1 1/2" = 3/4"     Thus, the allowance is 3/4".

## NOTES

**Air Conditioning:** Multiplication of fractions and mixed numbers is required when constructing items that must be in the proper proportion for strength, proper flow of air or other technical reasons. Students should estimate by rounding off to see if answer is reasonable.

**Welding:** A welder must determine the material needed for making more than 1 piece for a job. (Ex. -- 10 pieces 8 1/2" long)

## REFERENCE TO TEXT

**Applied General Mathematics** (AGM), pages 90-102

## EVALUATION

1. How long a piece of drill rod is required to make 20 drills 3 3/16" long if 1/8" waste is allowed for each cut? (Note: Only 19 cuts are made)

2. Calculate the weight of 12 bars of cold rolled steel, each bar 11 3/4' long if the stock weighs 2 3/8 lbs. per foot.

3. If there are 7 1/2 gallons to the cubic foot, how many gallons of oil will a 4 3/4 cubic feet tank hold?

4. $\frac{1}{4} \times 7\frac{1}{8} =$

## ANSWERS TO EVALUATION

1. $66\frac{1}{8}"$
2. $334\frac{7}{8}$ lbs.
3. $35\frac{5}{8}$ gallons
4. $1\frac{25}{32}$

## ANSWERS TO APPLICATIONS

1. $8\frac{1}{4}"$
2. $17\frac{7}{16}$ lbs.
3. $2\frac{11}{32}"$
4. $306\frac{1}{4}$ minutes
5. $42\frac{1}{2}"$
6. $115\frac{1}{2}"$
7. $157\frac{1}{2}"$
8. $16\frac{1}{8}$ hrs.
9. 200 hrs.
10. $25\frac{13}{16}$ ft.

11. a) $35\frac{5}{8}$"

b) $15\frac{7}{16}$"

c) $11\frac{9}{32}$"

12. a) $8\frac{1}{8}$"

b) $11\frac{1}{4}$"

c) $14\frac{3}{8}$"

13. $183\frac{6}{7}$ ft.

14. $4\frac{1}{2}$ tons

15. $38\frac{3}{4}$"

16. 58"

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #15

Performance Objective #15: Given any combination of fractions, mixed numbers and whole numbers, find the product.

1. To find the circumference of a circle, multiply the diameter by 3 1/7. What is the circumference of a circle whose diameter is 2 5/8"?

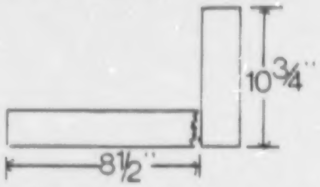
2. What is the weight of a piece of steel 15 1/2 feet long if the stock weighs 1 1/8 lbs. per foot?

3. How long a piece of stock will be required to cut 15 washers each 3/32" thick if 1/16" waste is allowed for each cut? (Note: 14 cuts)

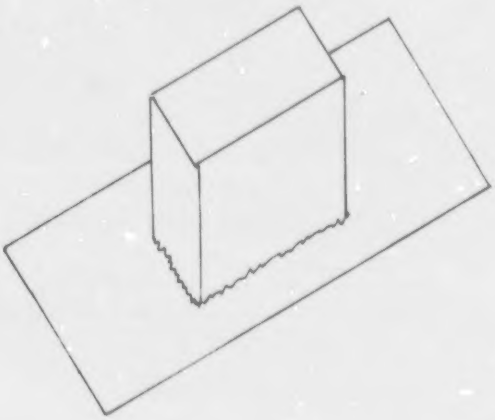
4. Allowing 1 1/2 minutes each time for putting away the finished work and placing the stock in the lathe, how long will it take to machine 25 pins if each pin requires 10 3/4 minutes to machine?

5. A welder needs 5 pieces of angle iron 8 1/2 inches long. How many inches of angle iron are needed for the job?

6. Six of these welded brackets are needed. What is the total length, in inches, of the stock needed for all the brackets?



7. This weldment takes 3 welding rods for the complete weld. In 8 hours, 52 1/2 of the weldments are completed. How many welding rods are used?



87

8. How long will it take to drive a 21 1/2 feet pipe into the earth if it takes 3/4 hr. per foot?

9. A room has 800 sq. ft. of wall area. It requires 1/4 hr. to install 1 ft. of wall covering. How long will it take to cover the walls of the room?

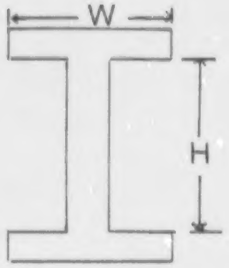
10. A log 7/8 the length of one 29 1/2 feet long is to be cut. What is the length?

11. The height of an I-beam is 2 3/8 times the width. Find the height for each of the following widths: 15", 6 1/2", 4 3/4".

a) When W is 15" then H = ________

b) When W is 6½" then H = ________

c) When W is $4\frac{3}{4}$" then H = ________



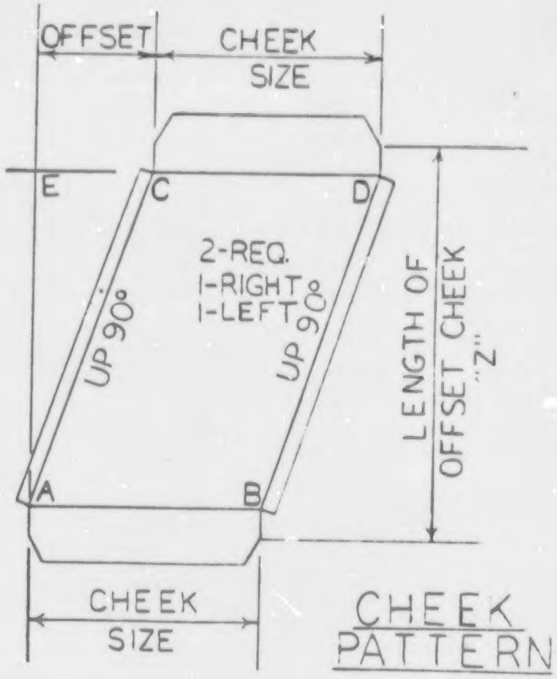
12. The pattern below contains an offset. The length of the offset cheek, dimension "Z", should be 2 1/2 times the offset. Find dimension Z when the offset is 3 1/4", 4 1/2", 5 3/4".

Dimension Z when offset is:

a) $3\frac{1}{4}$" = ________

b) $4\frac{1}{2}$" = ________

c) $5\frac{3}{4}$" = ________

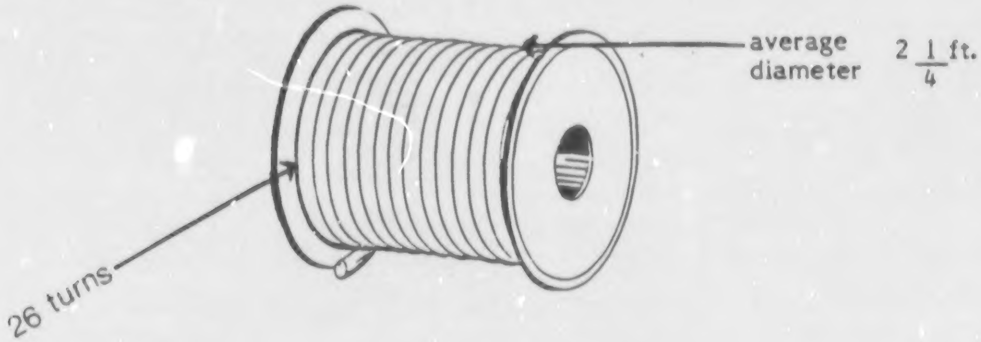

OFFSET
CHEEK SIZE
E
C
D
2-REQ.
1-RIGHT
1-LEFT
UP 90°
UP 90°
A
B
LENGTH OF OFFSET CHEEK "Z"
CHEEK SIZE
CHEEK PATTERN

13. The length of tubing in a roll may be estimated to keep from unrolling and measuring the tubing. The roll has 26 turns which were counted. The average diameter was fund to be 2 1/4 feet.

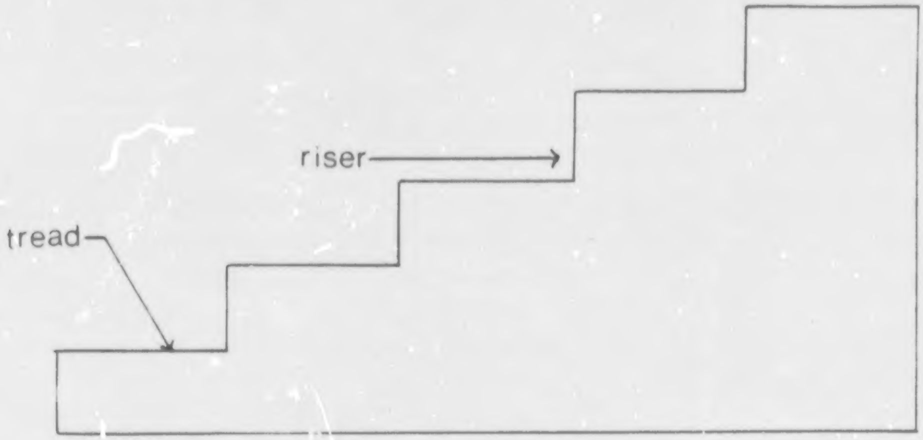
Solve for the length as follows.

Average diameter x $3\frac{1}{7}$ x number of turns = length

$2\frac{1}{4}$ x $3\frac{1}{7}$ x 26 = ________ approximate length



14. If it takes 1/2 ton of sand to lay 1,000 bricks, how many tons of sand will it take to lay 9,000 bricks?



15. If a flight of brick steps has 5 risers each of which is 7 3/4" high, what is the total height of the flight?

16. Find the height of the brick steps if there were 8 risers each 7 1/4" high.

## APPLIED VOCATIONAL MATHEMATICS

### COMPETENCY

Add, subtract, multiply and divide fractions.

### PERFORMANCE OBJECTIVE #16

Given any combination of fractions, mixed numbers and whole numbers, find the quotient.

### SAMPLE ITEM

How many 2 1/2 ft. boards can be cut from a board 12 1/2 feet long?

Solution: $12\frac{1}{2} \div 2\frac{1}{2} = 5$

### NOTES

Division of fractions, whole numbers, and mixed numbers is a skill needed by technicians to determine the cost of portions of a larger quantity and to determine the number of items that can be made from a given piece of material. Calculations made before taking action may save time, effort and resources.

Students must know how to change feet to inches to do these applications. Note that whole number answers are frequently needed.

### REFERENCE TO TEXT

**Applied General Mathematics** (AGM), pp. 103-115

### EVALUATION

1. If pitch = 1/number of threads per inch, what is the pitch of a screw having 7 1/4 threads per inch?
2. How many pieces 1 15/16 inches long can be cut from a strip of sheet metal 13 1/8 inches long?
3. A carpenter lays 12 1/2 squares of shingles in 5 1/2 days. What is average number of squares laid in one day?
4. $2\frac{1}{8} \div \frac{3}{4} =$

## ANSWERS TO EVALUATION

1. Pitch : $\frac{4}{29}$
2. 6 pieces
3. $2\frac{3}{11}$ squares
4. $2\frac{5}{6}$

## ANSWERS TO APPLICATIONS

1. a) $\frac{1''}{10}$

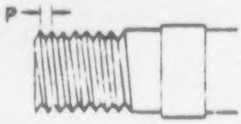
   b) $\frac{2''}{9}$

   c) $2\frac{2}{3}$ threads per inch
2. 5
3. 28 (and $\frac{1}{14}$)
4. $24\frac{1}{2}$ volts
5. 36
6. 6
7. 4
8. 36
9. 13
10. 153 (and $\frac{3}{5}$)
11. 6
12. 48
13. 8

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #16

Performance Objective #16: Given any combination of fractions, mixed numbers and whole numbers, find the quotient.

1. The pitch of a screw thread is the distance between the corresponding points of any two adjacent screw threads.



Since threads are always referred to as being so many to the inch, it follows that Pitch = 1 ÷ number of threads per inch, or Pitch = 1/no. of threads per inch.

From this, it follows that the number of threads per inch = 1 ÷ Pitch. To illustrate: what is the pitch of a screw having 8 threads per inch?

$$P = \frac{1}{8} = \frac{1''}{8}$$

What is the number of threads per inch, if the screw has a pitch of 3/16?

$$\text{No. of threads} = \frac{1}{\text{Pitch}} = 1 \div \frac{3}{16}$$

$$= 1 \times \frac{16}{3} = 5 - \frac{1}{3}$$

$5 - \frac{1}{3}$ threads per inch

a) Find the pitch of a screw having 10 threads per inch.

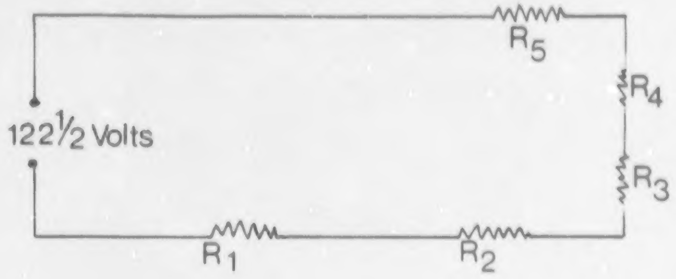
b) Find the pitch of a screw having 4 1/2 threads per inch.

c) Find the number of threads per inch of a screw having a pitch of 3/8".

2. A can of R-12 refrigerant contains 64 1/2 oz. Refrigerators are being repaired. Each one requires 12 1/4 oz. of refrigerant to be fully and correctly charged. How many refrigerators can be charged?

3. A strip of sheet metal is 49 1/8 inches long. How many pieces 1 3/4 inches long can be cut from the strip?

4. If 122 1/2 volts are distributed equally over each of the resistors shown below, find the average number of volts per resistor.



5. A 15-foot long piece of angle iron is in stock. How many 5-inch pieces can be cut from it?

6. How many 2 1/4 inch long pieces may be cut from a 14 3/4 inch length of channel iron?

7. A piece of key stock 15 1/4 inches long is in stock. How many keys 3 3/4 inches long may be cut from this stock?

8. How many pieces of tile 3/4 ft. long are required to cover a strip 27 feet long?

9. How many bricks 7 1/2 inches long can be laid in a row 97 1/2 inches long?

10. How many pieces of 5/8 inch plywood are there in a stack 8 feet high?

11. Find the number of risers 7 1/4" high that will be needed for a flight of brick steps that are 3' 7 1/2" high.

12. How many brick are needed to lay a rowlock course 11' if the width of the rowlock and mortar joint is 2 3/4"?

13. If a laborer can excavate 3 1/4 cubic yards of soil in one hour, how many hours will it take the laborer to remove 26 cubic yards of soil for footings?

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Make conversions within the customary system of measurement.

## PERFORMANCE OBJECTIVE #17

Given a linear measure in customary units, write an equivalent measure in another unit.

## SAMPLE ITEM

The woodworking instructor wishes to know how many 3-inch pieces may be cut from a board 6 1/2 feet long.

1. How many inches are in 6 1/2 feet?
2. How many pieces may be cut?

Solution (12" = 1 ft.)    6 1/2 x 12 = 78 inches    78" ÷ 3" = 26 pieces

## NOTES

Students should memorize basic units and their equivalents. Different trades work with different dimensions, but most use feet and inches. Students should know that linear refers to a measure of length. Be sure students know one abbreviation for commonly used units. This is an appropriate time to work with operations with measurements.

## REFERENCE TO TEXT

**Applied General Mathematics** (AGM), pages 274-290 (Note: Some of these pages include work unit operations with measures.)

## EVALUATION

1. 8 1/3 yds. = ____ ft.

2. 6 ft. = ____ in.

3. 3 yds. 1 ft. 4 in. = ____ in.

4. 86 in. = ____ ft. ____ in.

## ANSWERS TO EVALUAITON

1. 25 ft.
2. 72 in.
3. 124 in.
4. 7 ft. 2 in.

## ANSWERS TO APPLICATIONS

1. 72 inches
2. 4 feet 8 inches
3. 3 feet $6\frac{1}{4}$ inches
4. a) 48 in.
   b) 66 in.
   c) $3\frac{1}{4}$ ft.
   d) $29\frac{2}{3}$ yds.
   e) 15 ft.
   f) $2\frac{1}{3}$ yds.
   g) $2\frac{7}{18}$ yds.
   h) 12,700 microns
5. 252 inches
6. 24 feet
7. 3 ft.<br>
   36 in.

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #17

Performance Objective #17: Given a linear measure in customary units, write an equivalent measure in another unit.

1. A bricklayer is using a six-foot rule. How many inches are on this rule?

2. If a mason measures the width of an opening and finds it to be 56 inches, how many feet and inches does this represent?

3. A mason measures the distance from a foundation wall to the bottom of a window sill and finds the distance to be 42 1/4 inches. How many feet and inches is this?

4. Given: Linear Measurement Conversion

    12 in. = 1 ft.
    3 ft. = 1 yd.
    25,400 microns = 1 in.

    Change the following units of measure.

    a. 4 ft. = ______ in.

    b. $5\frac{1}{2}$ ft. = ______ in.

    c. 39 in. = ______ ft.

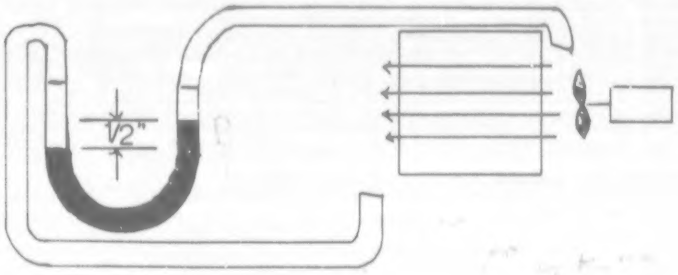
    d. 89 ft. = ______ yds.

    e. 5 yds. = ______ ft.

    f. 7 ft. = ______ yds.

    g. 86 in. = ______ yds.

    h. A "U" tube manometer reads one-half inch of mercury positive pressure. What would the reading be in microns?



5. A piece of 1-inch cold rolled steel in stock is 21 feet long. How many inches is in this piece?

6. If a steel tape measure is 288 inches long, how many feet are in the tape?

7. A yard stick has how many feet and how many inches?

## COMPETENCY

Find the perimeter of polygons using customary units.

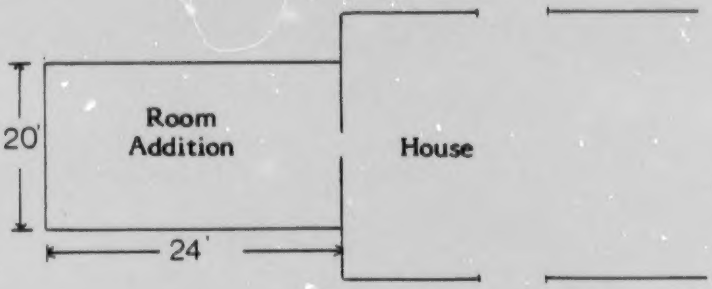
## PERFORMANCE OBJECTIVE #18

Given a polygon with dimensions in customary units, find the perimeter.

## SAMPLE ITEM

The Smith family is building a new room onto their home. The size of the room is 20 x 24 ft. How many feet of baseboard will it take to go around the room? (Disregard door opening).

P = (2 x L) + (2 x W)    2 x 20 = 40,    2 x 24 = 48,    40 + 48 = 88 ft.

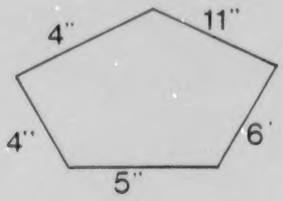


## NOTES

Perimeter frequently must be found before quantities of materials can be ordered.

## EVALUATION

1. Find the perimeter of a square room whose sides are 14 ft. each.
2. What is the perimeter in yards of a rectangle 29 ft. by 32 ft.?
3. Find the perimeter.



4. At the curb line, each side of a city block is 330 ft. If you go around the block, how far have you walked?

## ANSWERS TO EVALUATION

1. 56 ft.
2. $40\frac{2}{3}$ yds.
3. 30"
4. 1,320 ft.

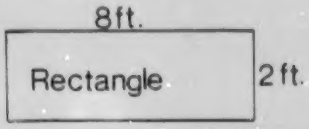
## ANSWERS TO APPLICATIONS

1. 20 ft.
2. 48 in.
3. 52"
4. $10\frac{3}{4}$ in.
5. 31 ft. 6 in.
6. $43\frac{1}{2}$ ft.
7. a) 24"
   b) 6"
   c) 33"
8. 88'
9. 664 ft.
10. 74 ft.
11. 4,160 ft.
12. a) 6"
    b) $6\frac{1}{4}$"
    c) 6"

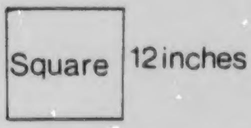
### APPLICATIONS
### FOR
### PERFORMANCE OBJECTIVE #18

Performance Objective #18: Given a polygon with dimensions in customary units, find the perimeter.
The perimeter of a polygon is the sum of the length of the sides. Find the perimeters of the following polygons.

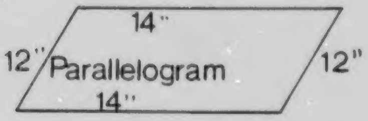
1.


8ft.
Rectangle
2 ft.

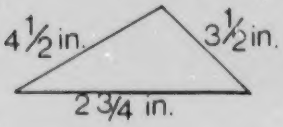
2.


Square
12 inches

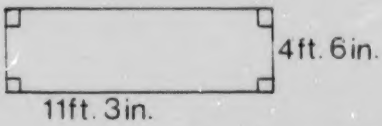
3.


14"
12"
Parallelogram
12"
14"

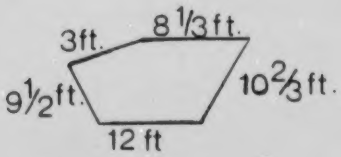
4.


4½ in.
3½ in.
2 3/4 in.

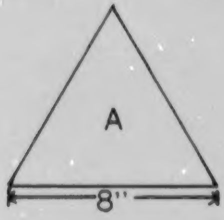
5.

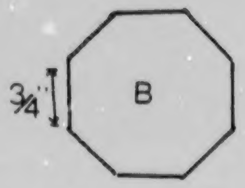

4ft. 6in.
11ft. 3in.

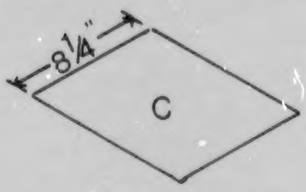
6.


3ft.
8 1/3 ft.
9½ ft.
10⅔ ft.
12 ft

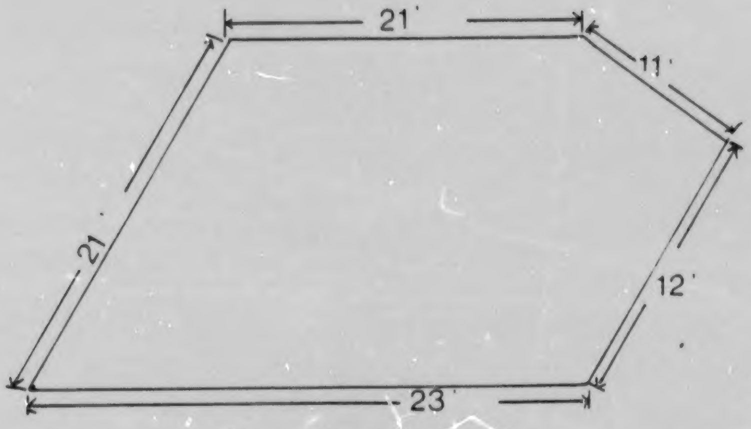
7. These 3 shapes are cut from 1/4 inch steel plate. Find the perimeter of each. (Each figure is a regular polygon.)







8. Find the perimeter of this work area.



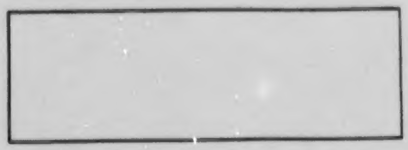
9. Find the perimeter of a rectangular plot of land 112 ft. wide and 220 ft. long.

10. How many linear feet of crown moulding is required for a room 16' x 21'?

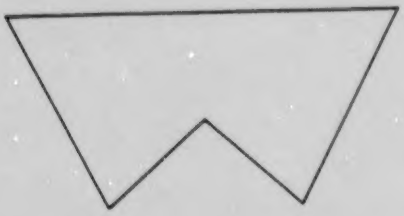
11. A new area has been added to the city park with outside dimensions of 1,040 ft. x 1,040 ft. What is the distance, in feet, around it?

12. Use your ruler to measure the sides in each of the following figures to the nearest quarter inch, then give the perimeter. Note: answers will vary because of changes which occur during printing.

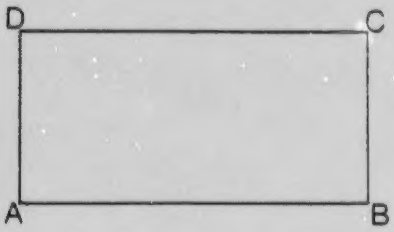
A.



B.



C.



# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

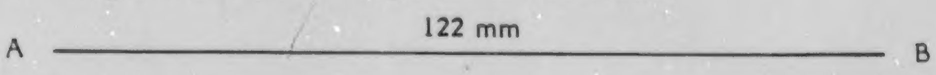
Read a metric ruler.

## PERFORMANCE OBJECTIVE #19

Given a line segment and a ruler, measure the length of the segment to the nearest millimeter.

## SAMPLE ITEM

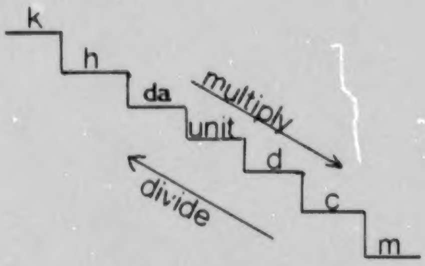
How long is it from point A to point B in millimeters?



## NOTES

Anyone doing sheet metal work routinely uses a steel ruler to lay out patterns. Accuracy is very important. Practice to develop skills in measuring may be obtained by determining lengths of lines of scale drawings of sheet metal patterns.

**General:** After students begin using a metric ruler, they can be given instructions on changing from one metric unit to another. Stress moving decimals using a model such as the following.



Conversion is handled in depth later, so do not over do at this time. Multiplying by powers of ten is accomplished by moving the decimal to the right. To divide, move the decimal to the left.

Students will find the basic unit of length spelled both meter and metre. Stress that m, cm, mm, etc. are symbols and not abbreviations. The symbols are not followed by periods or s's for plural.

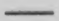
Measurements are typically given in one unit, not mixed. For example, the length above could be written as 122 mm or 12.2 cm but not 12 cm 2 mm. Decimeters are seldom used except as a reference.

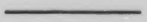
REFERENCE TO TEXT

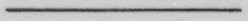
Applied General Mathematics (AGM), pages 291-305

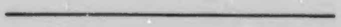
EVALUATION

Give the length of each of these segments to the nearest millimeter.

1. 

2. 

3. 

4. 

## ANSWERS TO EVALUATION

1. 7 mm
2. 20 mm
3. 34 mm
4. 48 mm

## ANSWERS TO APPLICATIONS

1. a) 104 mm
   b) 37 mm
   c) 115 mm
2. a) 81 mm
   b) 62 mm
   c) 119 mm
   d) 105 m
   e) 83 mm
   f) 35 mm
   g) 116 mm
   h) 92 mm
   i) 105 mm
3. AJ = 50 mm
   AC = 64 mm
   AH = 25 mm
   CF = 25 mm
   JK = 27 mm
   JF = 68 mm

Note: Answers may vary due to measuring instruments or alterations occurring during printing.

4. AA = 33 mm

AB = 12 mm

BC = 45 mm

AC = 57 mm

CD = 4 mm

AD = 61 mm

5. AB = 25 mm

BC = 4 mm

AD = 29 mm

CH = 42 mm

DE = 42 mm

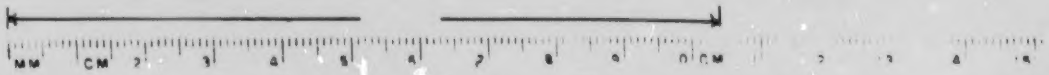
FG = 25 mm

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #19

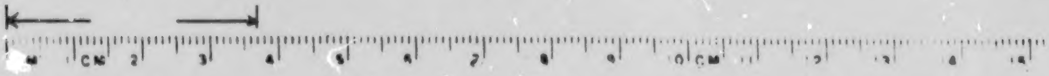
Performance Objective #19: Given a segment and a ruler, measure the length of the segment to the nearest millimeter.

1. Read each of the following metric rulers at the mark indicated. Give the reading to the nearest millimeter.

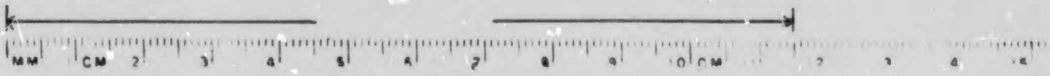
a)


MM
CM
2
3
4
5
6
7
8
9
10 CM
2
3
4
5

b)


MM
CM
2
3
4
5
6
7
8
9
10 CM
2
3
4
5

c)


MM
CM
2
3
4
5
6
7
8
9
10 CM
2
3
4
5

2. Using a rule, determine the length of each line segment to the nearest millimeter.

a) ________________________________

b) ________________________

c) ______________________________________________

d) ________________________________________

e) ________________________________

f) ______________

g) ____________________________________________

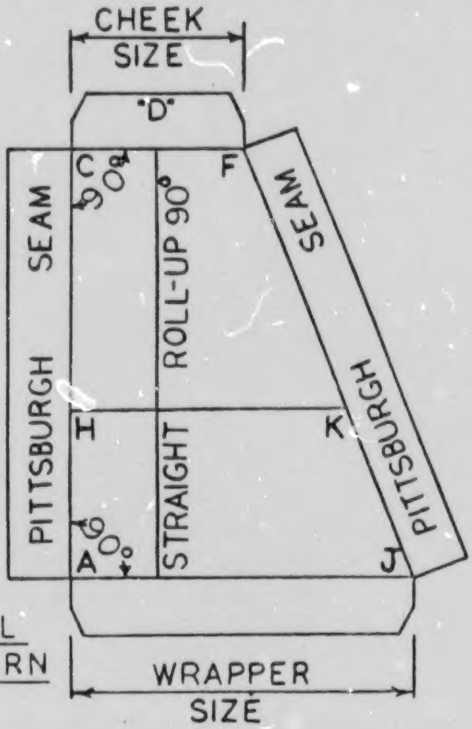
h) ___________________________________

i) ________________________________________

3. Sheet metal patterns are used to assist in laying out fittings. The patterns are not dimensioned so they can be used to make any size fitting.

On the given sheet metal patterns, lengths of lines are identified by letters, for example, AA or AB.

Measure the line segments identified below and record the length to the nearest millimeter.


CHEEK SIZE
"D"
C
90°
F
SEAM
ROLL-UP 90°
SEAM
PITTSBURGH
H
K
PITTSBURGH
STRAIGHT
90°
A
J
PITTSBURGH
WRAPPER SIZE

HEEL PATTERN

AJ = ____________

AC = ____________

AH = ____________

CF = ____________

JK = ____________

JF = ____________

4. Measure each segment to the nearest millimeter.

AA = ____________

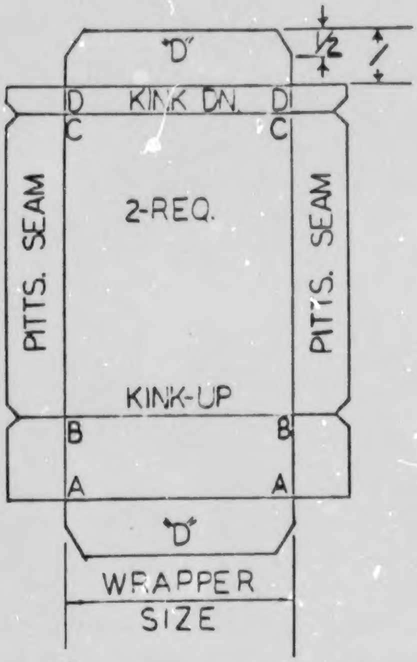
AB = ____________

BC = ____________

AC = ____________

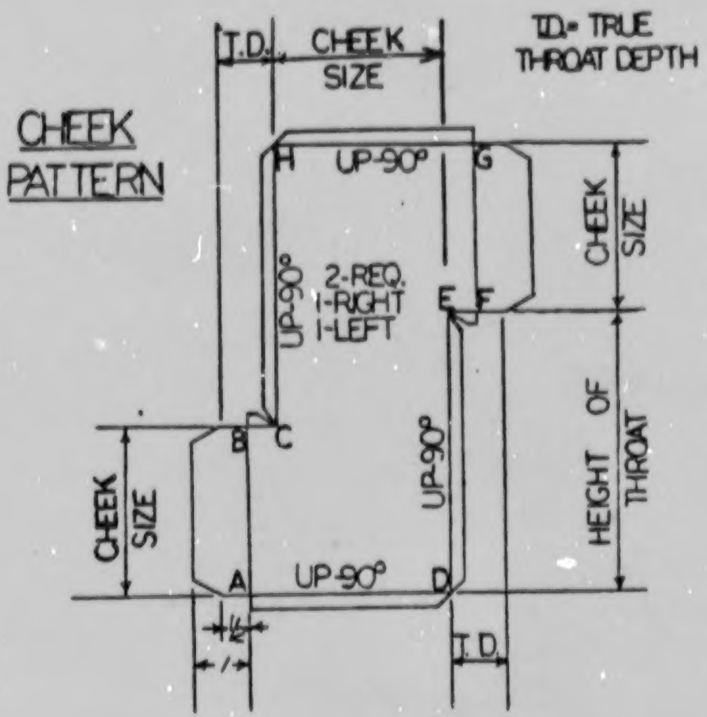
CD = ____________

AD = ____________


"D"
1/2
1
D
KINK DN.
D
C
C
PITTS. SEAM
2-REQ.
PITTS. SEAM
KINK-UP
B
B
A
A
"D"
WRAPPER SIZE

HEEL PATTERN

5. Measure each segment to the nearest millimeter.


CHEEK PATTERN
T.D.
CHEEK SIZE
T.D.= TRUE THROAT DEPTH
H
UP-90°
G
CHEEK SIZE
UP-90°
2-REQ.
1-RIGHT
1-LEFT
E
F
B
C
UP-90°
HEIGHT OF THROAT
CHEEK SIZE
A
UP-90°
D
1/2
1
T.D.

AB = ______________

BC = ______________

AD = ______________

CH = ______________

DE = ______________

FG = ______________

## APPLIED VOCATIONAL MATHEMATICS

### COMPETENCY

Read and write decimals.

### PERFORMANCE OBJECTIVE #20

Given a list of decimal fractions in numerical form and a list in word form, match equivalent forms.

### SAMPLE ITEM

.001 is one thousandth

### NOTES

**General:** In some trades, all decimals are read as thousandths regardless of how they are written. For example, in machine shop, 0.1 is read as one hundred thousandths.

Students must be able to hear a measurement and write it accurately. For this reason, a worthwhile activity is to call out lists of decimals and have the students write them. Students should know to read the decimal point as "and" — not point.

### RESOURCES

**Applied General Mathematics** (AGM), pages 125-131

### EVALUATION

Match the written expression with the numerical form:

1. one hundredth
2. one tenth
3. one thousandth
4. one hundred one thousandths

a) 0.101

b) 0.1

c) 0.01

d) 0.001

e) 0.11

## ANSWERS TO EVALUATION

1. c
2. b
3. d
4. a

## ANSWERS TO APPLICATIONS

1. a) 0.76
   b) 0.405
   c) 0.0064
   d) 0.00094
   e) 0.4
2. a) 4
   b) 8
   c) 1
   d) 2
   e) 7
   f) 5
   g) 6
3. 1. d
   2. a
   3. e
   4. b
   5. c

## APPLICATIONS
## FOR
## PERFORMANCE OBJECTIVE #20

Performance Objective #20: Given a list of decimal fractions in numerical form and a list in word form, match equivalent forms.

1. In solving problems, written numbers must be expressed in numerical form. Express the following written decimals in numerical form.

   a) Seventy-six hundredths

   b) Four hundred five thousandths

   c) Sixty-four ten-thousandths

   d) Ninety-four hundred-thousandths

   e) Four tenths

2. Column I lists decimal fractions in word form. Column II list decimal fractions in numerical form. Give the number of the numerical form that matches the word forms.

   **COLUMN I**

   a) Six hundredths

   b) Four and twenty-seven thousandths

   c) Forty-seven thousandths

   d) Seven ten-thousandths

   e) Seven thousand forty-seven ten-thousandths

   f) Thirty-four point six five four

   g) Three hundred forty-seven thousandths

   **COLUMN II**

   1. 0.047
   2. 0.0007
   3. 0.7470
   4. 0.06
   5. 34.654
   6. 0.347
   7. 0.7047
   8. 4.027
   9. 0.60

3. Match the decimal fractions in Column II to the word numbers in Column I.

| | COLUMN I | | COLUMN II |
|---|---|---|---|
| 1. | Twenty-eight hundredths | a) | 0.0028 |
| 2. | Twenty-eight ten-thousandths | b) | 0.2800 |
| 3. | Two and eight thousandths | c) | 2.80 |
| 4. | Two thousand eight hundred ten-thousandths | d) | 0.28 |
| 5. | Two and eighty hundredths | e) | 2.008 |

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Compare decimals.

## PERFORMANCE OBJECTIVE #21

Given two decimal fractions, tell which is larger or state that they are equivalent.

## SAMPLE ITEM

Replace the ? with <, > or =.

0.81 ? 0.081 (ans: >)

## NOTES

**General:** An easy way to compare decimals is to list them vertically lining up the decimal points. Add enough zeroes at the end to make the numbers have the same number of digits. Comparison is then made of the same place value.

Metal, wire, cable and small copper tubing are used in many trade areas. These items are identified by decimal fractions. Students must be able to compare correctly various decimal sizes.

## EVALUATION

Replace the ? with <, >, or =.

1. 0.101 ? 0.011
2. 0.6 ? 0.125
3. 0.041 ? 0.421
4. 0.3 ? 0.300

## ANSWERS TO EVALUATION

1. $>$
2. $>$
3. $<$
4. $=$

## ANSWERS TO APPLICATIONS

1. a) H
    b) E
    c) 6
2. 0.035
3. b
4. b
5. a) $<$
    b) $=$
    c) $<$
    d) $=$
    e) $>$
    f) $<$

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #21

Performance Objective #21: Given two decimal fractions, tell which is larger or state that they are equivalent.

1. Drill bits are identified by letter (Z-A) and by numbers (1-80). Each letter drill and number drill is assigned a decimal fraction size. Compare the following drills. Which is the larger in each pair?

   a) A is 0.234 compared to H is 0.358.

   b) E is 0.25 compared to 5 is 0.2055.

   c) 6 is 0.24 compared to 73 is 0.024.

2. Tubing is identified by outside diameter and is made in various wall thicknesses for different strengths.

   1/8" tube comes in two wall thicknesses: 0.028 and 0.035. Which is larger?

3. A 1/8 or D.125 inch hole is to be drilled and then counter bored with a larger drill. Which drill would you use to counter bore?

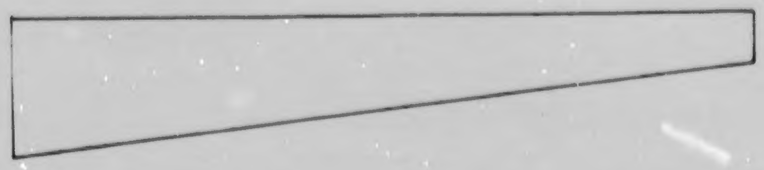
   a) 0.109375

   b) 0.15625

4. When given the dimensions of a tapered pin, the machinest must determine which is the larger dimension.

   a) dimension 1.505 in.

   b) dimension 1.550 in.



5. Using the symbols >, < and =, make the following statements true.

   a) .06 ? .60

   b) 1.01 ? 1.010

   c) .005 ? .050

   d) 0.3 ? 0.30

   e) 0.018 ? 0.0018

   f) 0.005 ? 0.10

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Convert decimals to common fractions and vice versa.

## PERFORMANCE OBJECTIVE #22

Given a list of common fractions and a list of decimal fractions, match equivalent forms.

## SAMPLE ITEM

$\frac{3}{4} = ?$

a) .60
b) .75
c) .66

(ans: b)

## NOTES

Common fractions and decimals are frequently mixed in the same problem making conversion from one form to the other mandatory. Rounding decimals is also an important skill at this time.

In doing repair work, parts are replaced. The original specifications may have been stated in decimal form and the replacement in common fraction form.

When fabricating items specifications may be given in either decimal or common fraction form or a combination of both.

The student must be able to match equivalent forms.

The rafter tables on the framing square used by carpenters show the rafter lengths per foot of run. Decimals are used instead of common fractions. The carpenter should be familiar with the decimal equivalents of each 1/16" in an inch.

## REFERENCE TO TEXT

Decimal Equivalents Chart
**Applied General Mathematics** (AGM), pages 132-140

## EVALUATION

Match the common fractions on the left with the decimal equivalent on the right. (Decimals are rounded to the nearest ten thousandths.)

1. $\frac{1}{64}$
2. $\frac{3}{4}$
3. $\frac{1}{8}$
4. $\frac{3}{16}$
5. $\frac{5}{8}$
6. $\frac{1}{2}$

a. 0.1250

b. 0.0156

c. 0.5000

d. 0.7500

e. 0.6250

f. 0.1875

g. 0.5625

## ANSWERS TO EVALUATION

1. b
2. d
3. a
4. f
5. e
6. c

## ANSWERS TO APPLICATIONS

1. a) 6
   b) 1
   c) 7
   d) 2
   e) 4
   f) 3
   g) 5

2. a) 0.8125
   b) 0.0469
   c) 0.328
   d) 0.6563
   e) 0.250
   f) 0.375

3. a) 0.265625
   b) 0.375
   c) 0.625
   d) 0.3125
   e) 0.4375
   f) 0.15625

4. a) 0.4219
   b) 0.9375
   c) 0.625
   d) 0.25
   e) 0.375
   f) 0.5

5. 0.67

6. 0.6875

7. $0.83\frac{1}{3}$

8. 0.405

9. $\frac{75}{100} = \frac{3}{4}$

10. $\frac{80}{100} = \frac{4}{5}$

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #22

Performance Objective #22: Given a list of common fractions and a list of decimal fractions, match equivalent forms.

1. Match the list of common fractions to the list of decimal fractions.

A. $\frac{1}{8}$

B. $\frac{1}{4}$

C. $\frac{3}{8}$

D. $\frac{1}{2}$

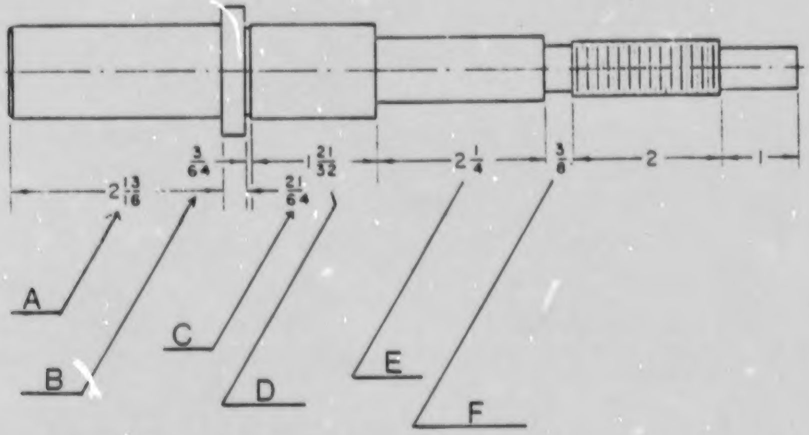
E. $\frac{3}{4}$

F. $\frac{2}{3}$

G. $\frac{1}{5}$

1. 0.250
2. 0.500
3. $0.66\frac{2}{3}$
4. 0.750
5. 0.200
6. 0.125
7. 0.375

2. Match the common fractions with the correct decimal fraction below. Consider the fraction portion only.

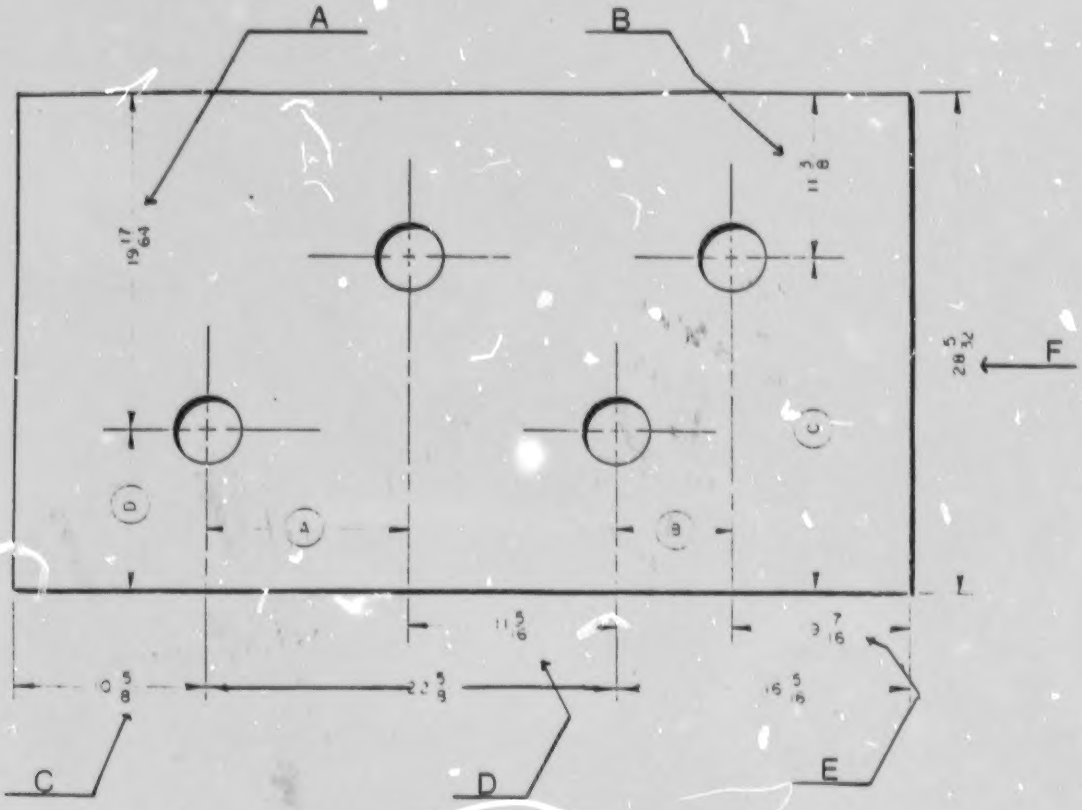


$2\frac{13}{16}$
$\frac{3}{64}$
$1\frac{21}{32}$
$\frac{21}{64}$
$2\frac{1}{4}$
$\frac{3}{8}$
2
1
A
B
C
D
E
F

0.250
0.3125
0.328
0.375
0.6563

0.6875
0.8125
0.0938
0.6563
0.0469

3. Match the common fraction with the decimal fraction by choosing the decimal fraction from the list below. Consider the fraction portion only.

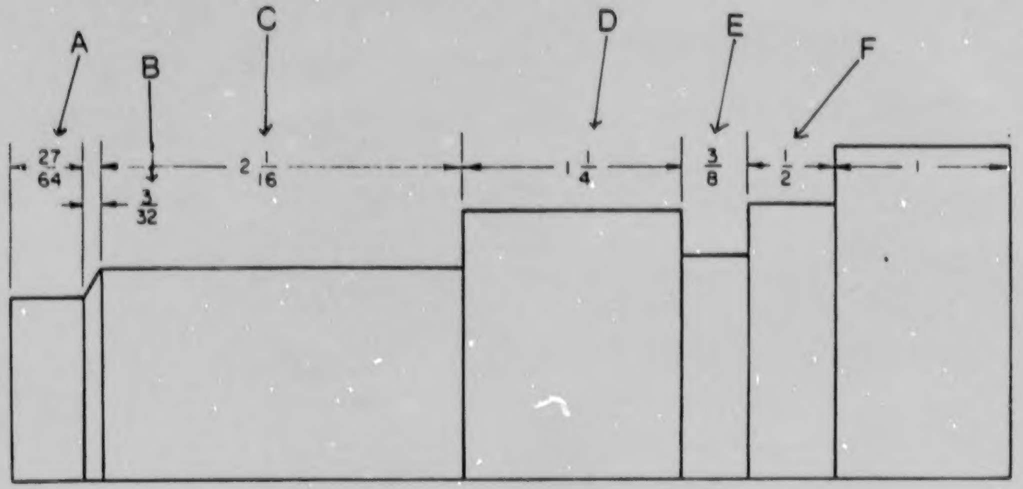

A
B
19 17/64
11 3/8
28 5/32
F
(C)
(D)
(A)
(B)
11 5/16
3 7/16
10 5/8
22 5/8
16 5/16
C
D
E

0.0937
0.15625
0.265625
0.3125

0.375
0.4375
0.500
0.625

4. Match the common fraction with the decimal fraction by choosing the decimal fraction from the list below. Consider the fraction portion only.

0.03125
0.0625
0.09375
0.125
0.1875
0.25
0.3125
0.375
0.4219
0.5
0.625



5. What decimal part of a dollar is 67 cents?

6. What decimal fraction of a pound is 11 ounces?

7. 120 square inches is what decimal fraction of a square foot?

8. Change 700 cubic inches to a decimal fraction of a cubic foot. (1 cubic foot = 1728 cubic inches.)

9. What fractional part of a dollar is 75 cents?

10. What fractional part of our work is correct when we get a test mark of 80 per cent?

## COMPETENCY

Add, subtract, multiply and divide decimals.

## PERFORMANCE OBJECTIVE #23

Given two decimal numbers, find the sum.

## SAMPLE ITEM

A machinist purchases a new micrometer for $39.50 and a steel rule for $2.95. How much did he/she spend all together?
(ans: $42.45)

## NOTES

Two major uses of decimals in the vocational world are as money and as measurements. Some time clocks are hundredths clocks.

Sometimes common fractions and decimal fractions are mixed in the same problem.

Even though students use calculators frequently, the teacher must be certain that they know to line up decimals for adding and subtracting.

Construction workers use simplified slide rule-type devices for solving problems. Most of these devices display decimals, not common fractions. The student should become familiar with the operations using decimals instead of common fractions.

## REFERENCE TO TEXT

**Applied General Mathematics** (AGM), pages 140-143

## EVALUATION

1. One bag of sand weighs 13.82 kilograms. Another bag weighs 21.3 kilograms. How much do they weigh together?
2. It rained three days last week. Find the total rainfall if it rained 1.04 inches Monday, 0.8 inches Tuesday and 0.43 inches Thursday.
3. Add: 63.8 + 5 + 0.31
4. A repair order had parts listed as $17.83, $9.15 and $36.43. Find the total cost of the parts.

## ANSWERS TO EVALUATION

1. 35.12 kg
2. 2.27 inches
3. 69.11
4. $63.41

## ANSWERS TO APPLICATIONS

1. $1,771.45
2. $80.84
3. $3,669.15
4. a) 18.198"
   b) 8.904"
   c) 1.014"
5. 5.11
6. 3.046 amperes
7. 9.724 amperes
8. 2.281"

9 3.093"

10. 111.5 mm
11. 2.375" or $2\frac{3'}{8}$
12. 2.281"
13. 3.09325"
14. 2.2"
15. 12.25'
16. 7.75'
17. 11.015 cubic yards

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #23

Performance Objective #23: Given two decimal numbers, find the sum.

1. A contractor purchased the following equipment: wheel barrow $59.95; mortar hoe $16.50; mortar mixer $1,695. What was the total cost of this equipment?

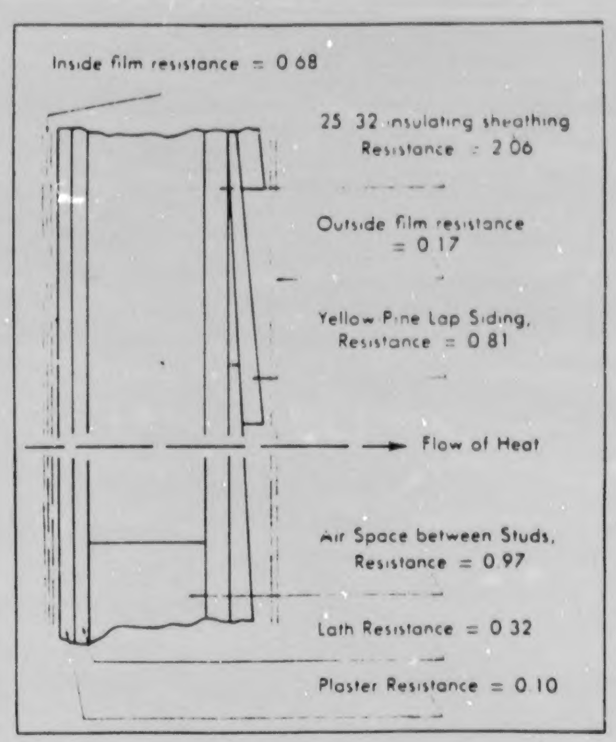
2. A bricklayer's bill was: brick set, $7.50; plasterer's hawk, $13.25; level, $45; pointing trowel, $2.50; brick hammer, $12.59. What was the total bill?

3. A contractor's payroll for one week was: bricklayers - $1530.40; carpenters - $1,139.85; laborers - $809.50; bookkeeper - $189.40. What is the total amount of the payroll?

4. Given the tolerances below, find the longest length possible.

| | Dimension | Tolerance |
|---|---|---|
| a) | 18.136" | ±.062" |
| b) | 8.899" | ±.005" |
| c) | 1.002" | ±.012" |

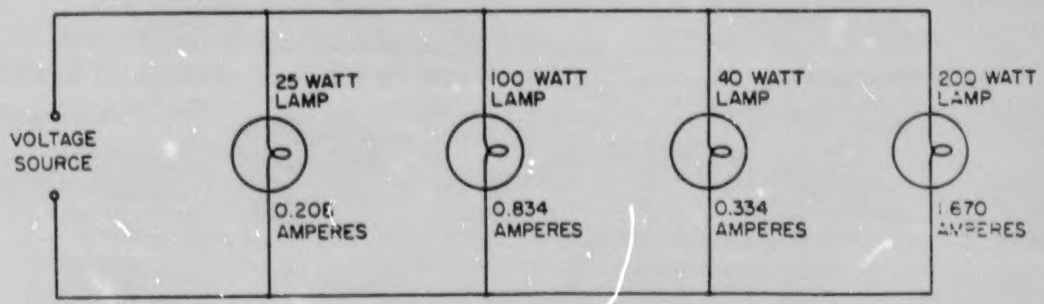
5. Find the total thermal resistance for the wall construction shown below by adding all of the individual resistances.


Inside film resistance = 0.68
25/32 insulating sheathing Resistance = 2.06
Outside film resistance = 0.17
Yellow Pine Lap Siding, Resistance = 0.81
Flow of Heat
Air Space between Studs, Resistance = 0.97
Lath Resistance = 0.32
Plaster Resistance = 0.10

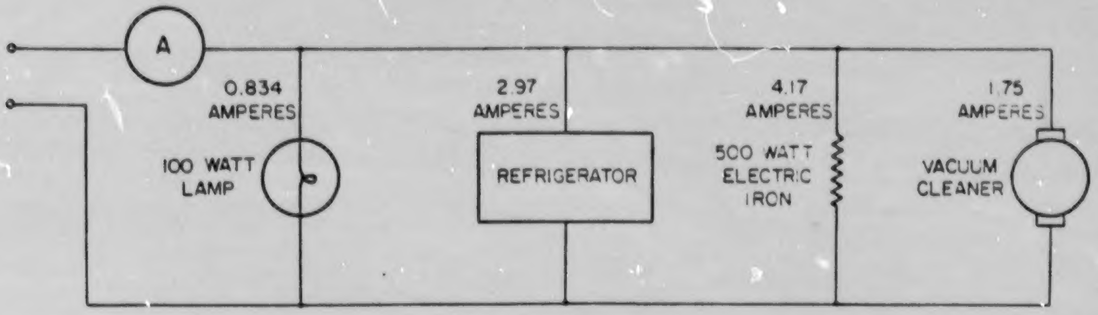
Thermal resistance for wall construction

BEST COPY AVAILABLE

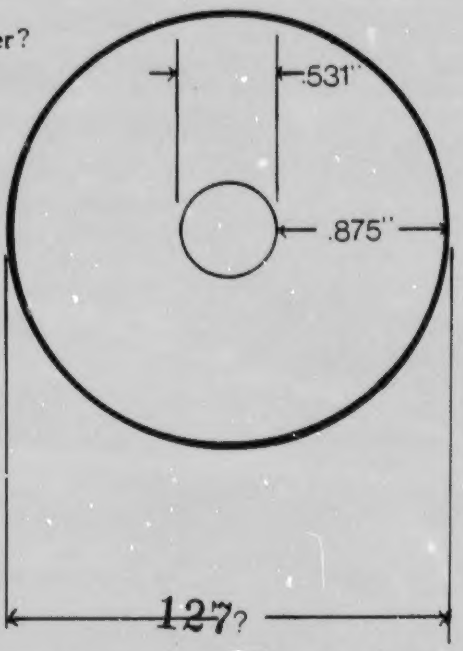
6. If the total current (amperes) in the figure below is equal to the sum of the individual currents, find the total current.


VOLTAGE SOURCE
25 WATT LAMP
0.208 AMPERES
100 WATT LAMP
0.834 AMPERES
40 WATT LAMP
0.334 AMPERES
200 WATT LAMP
1.670 AMPERES

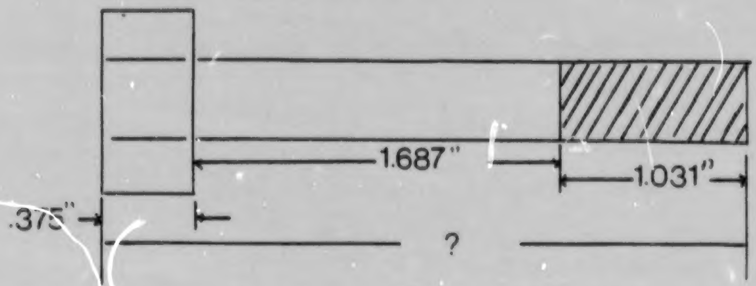
7. The total current in the figure below is measured by the ammeter A. The total current in amperes is distributed in the circuit as shown. Find the total current reading on the ammeter.


A
0.834 AMPERES
100 WATT LAMP
2.97 AMPERES
REFRIGERATOR
4.17 AMPERES
500 WATT ELECTRIC IRON
1.75 AMPERES
VACUUM CLEANER

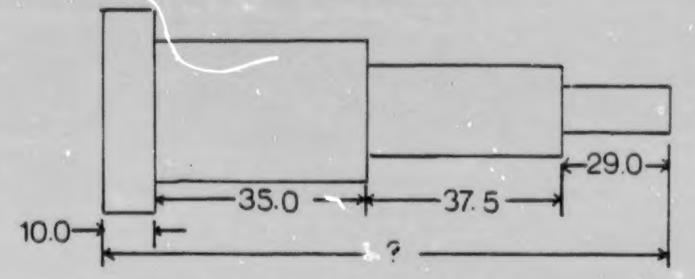
8. What is the diameter of this washer?



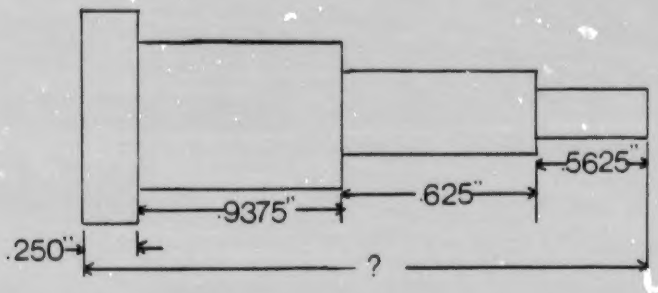
9. What is the length of this bolt?


1.687"
1.031"
.375"
?

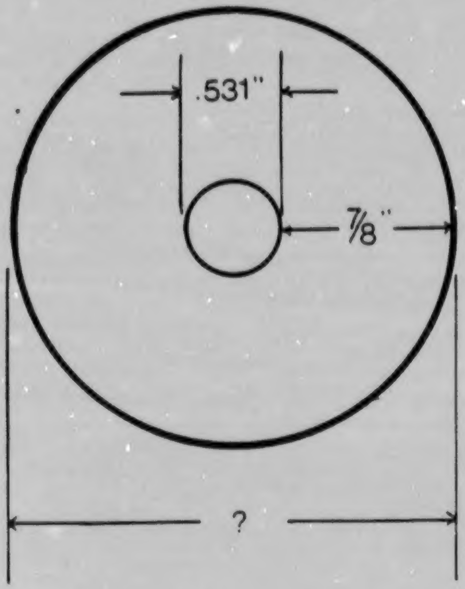
10. Find the over-all length in millimeters of this step-pin.


29.0
35.0
37.5
10.0
?

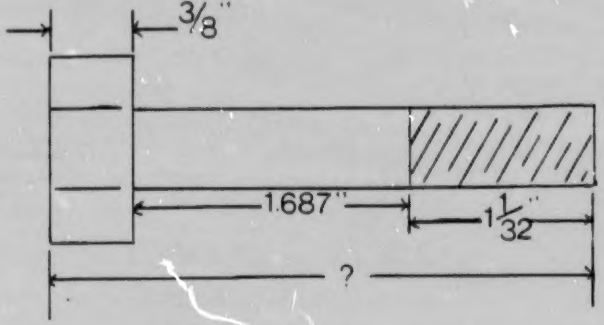
11. The machine shop student must find the over-all length of a step pin. Give answer in decimal form and the common fraction equivalent.


.5625"
.625"
.9375"
.250"
?

12. Give the diameter of the washer in decimal form.



13. Give the length of this bolt in decimal form.



Solve the following problems by addition.

14. What is the total thickness of three metal plates .625", .75" and .825"?

15. The length of one piece of lumber is 5.50' and another piece is 6.75'. What is the total length of the two pieces?

16. The Smith family is planning to construct a piece of furniture for their lawn. The plan requires 1 piece of 2 x 4, 1.5' long, 1 piece 3.75' long and 1 piece 2.25' long. What length piece of 2 x 4 is needed to cut all of these pieces from? Add .25' for waste and kerfs.

17. What is the total amount of concrete required if one footing requires 6.125 cubic yards and another requires 4.89 cubic yards?

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Add, subtract, multiply and divide decimals.

## PERFORMANCE OBJECTIVE #24

Given two decimal numbers, find the difference.

## SAMPLE ITEM

Subtract: 8.3" - 1.215" (ans: 7.085")

## REFERENCE TO TEXT

**Applied General Mathematics** (AGM), pages 143 - 151

## EVALUATION

1. One day an electric meter registered 328.6 KWH. The next day it registered 337.2 KWH. How much electricity was used during the period?
2. At one store a part cost $83.74. The same part cost $69.21 at a second store. How much less was the part at the second store?
3. A tapered pin has a large diameter of 2.03" and a small diameter of 1.624". Find the difference.
4. Subtract: 8 - 3.21

## ANSWERS TO EVALUATION

1. 8.6 KWH
2. $14.53
3. 0.406"
4. 4.79

## ANSWERS TO APPLICATIONS

1. 0.5625 inches
2. 1.154 ohms
3. 0.75 amperes
4. 0.75"
5. 1.408"
6. .984375"
7. 1.68775"
8. $6,959.60
9. $590.48
10. $120.98
11. 2.189 cm
12. 25 mm
13. 0.9375"
14. 56.2 ft
15. 0.035"
16. 4.407 lbs.
17. $4,720.27
18. a) 18.074"
    b) 8.894"
    c) 0.990"

## APPLICATIONS
## FOR
## PERFORMANCE OBJECTIVE #24

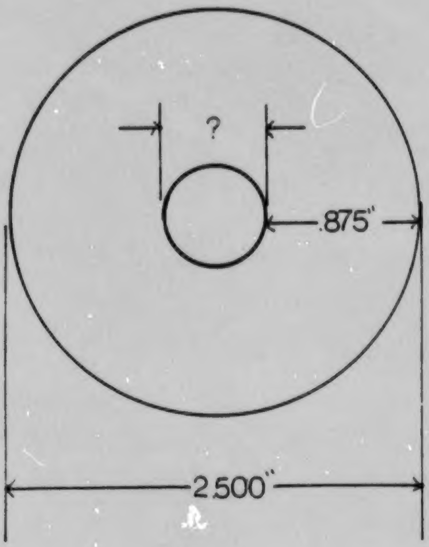
Performance Objective #24: Given two decimal numbers, find the difference.

1. A bearing bushing has an outside diameter (O.D.) of 3.9375 inches and an inside diameter (I.D.) of 3.375 inches. What is the thickness of the wall?

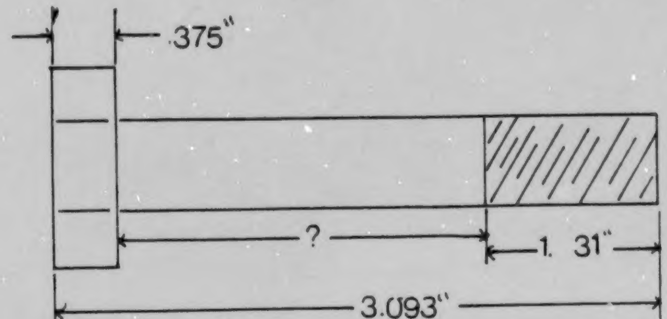
2. The cold resistance of an armature measures 0.096 ohms. After being run for 5 hours, the resistance is 1.25 ohms. What is the difference in the resistance?

3. The field current of a motor is 1.12 amperes at no load. However, when the full load is applied, the current increases to 1.87 amperes. What is the difference in amperes from no load to full load?

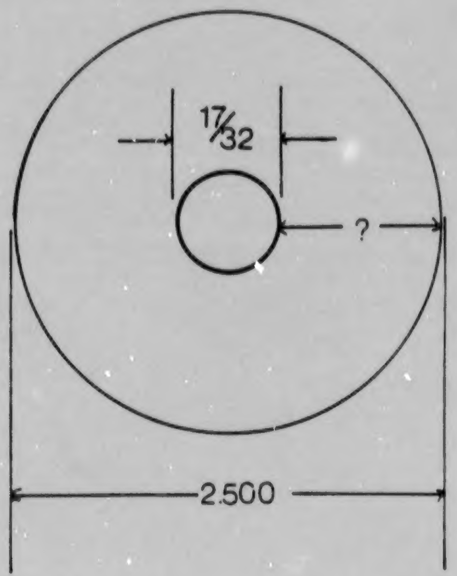
4. What is the diameter of the hole in this washer?



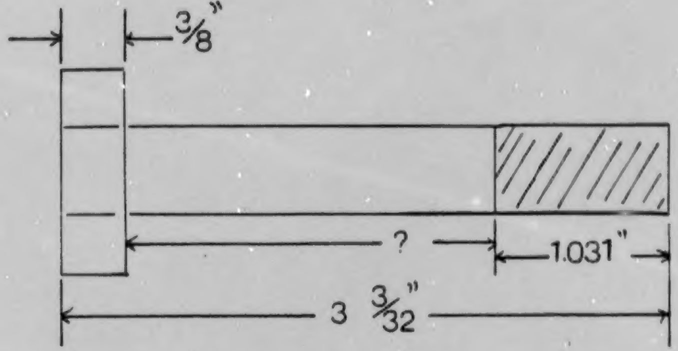
5. What is the body length of this bolt?



6. What is the body thickness of this washer?



7. What is the body length of this bolt? (Give the answer as a decimal number.)

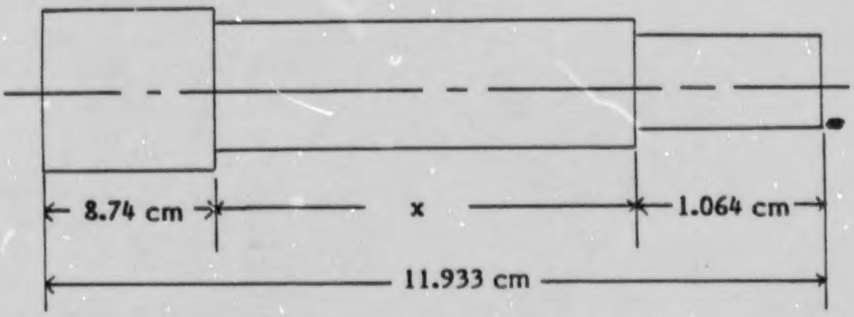


8. A contractor is buying a new truck costing $11,150.35. The contractor is allowed $4,190.75 for the old truck. How much actual money will the contractor pay for the new truck?

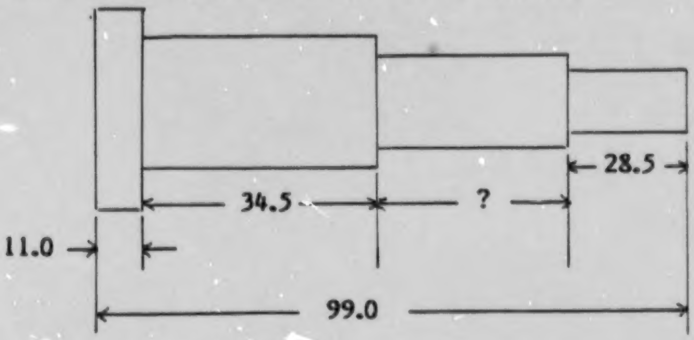
9. A contractor received $1,150 for a job. The material and labor cost $559.52. What was the amount of the contractor's profit?

10. The materials for a rock retaining wall came to $342.50. The labor was $286.52. The contractor received $750.00 for the job. What was the contractor's profit?

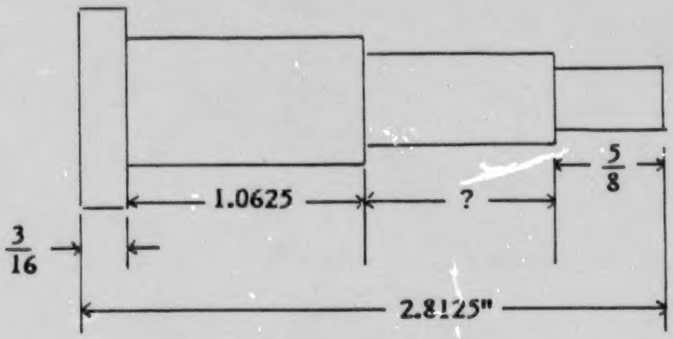
11. Find X.


8.74 cm
x
1.064 cm
11.933 cm

12. Find the missing metric dimension of this step pin.


28.5
34.5
?
11.0
99.0

13. The machine shop student must find the length of the missing dimension to produce this part. Give answer as a decimal number.


$\frac{5}{8}$
1.0625
?
$\frac{3}{16}$
2.8125"

14. In civil engineering, tenths of a foot is used instead of inches. How much longer is a lot 198.6 ft. than a lot 142.4 ft.?

15. Nails are assigned a number in pennies (d) such as $6^d$ or six penny. The diameter of a nail is expressed as a decimal. A $6^d$ nail is 0.113" in diameter; a $10^d$ nail is 0.148. How much greater in diameter is the $10^d$ nail than the $6^d$ nail?

16. The weight of one cubic foot of one solution is 10.765 pounds and the weight of one cubic foot of another solution is 15.172 pounds. How much heavier is the second solution than the first?

17. A building contractor paid $5,680.45 for labor and other expenses for a job that paid him $10,400.72. What was his profit?

18. Given the tolerances below find the shortest length possible.

| | Dimension | Tolerance |
|---|---|---|
| a) | 18.136" | ± .062" |
| b) | 8.899" | ± .005" |
| c) | 1.062" | ± .012" |

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Add, subtract, multiply and divide decimals.

## PERFORMANCE OBJECTIVE #25

Given two decimal numbers, find the product.

## SAMPLE ITEM

A truck is loaded with 50 parts. Each part weighs approximately 16.8 kilograms. What is the total weight of the load? (ans: 840 kg)

## NOTES

Students should be able to multiply and divide by powers of ten mentally by moving the decimal the appropriate number of places. This skill is particularly important in working with the metric system and in estimating.

Rounding answers is frequently necessary in multiplying and dividing decimals when at least one of the numbers is a measure. A total measure found by arithmetic should not have more decimal places than the least precise of the measurements used to get the answer.

## REFERENCE TO TEXT

**Applied General Mathematics** (AGM), pages 152-164

## EVALUATION

1. The thickness of a piece of sheet metal is 0.218". What is the thickness of 15 sheets of this metal?
2. A mechanic works at a job for 3.5 hours. The garage pays the mechanic $5.15 an hour. How much does the job cost?
3. A certain steel bar weighs 3.4 pounds per linear foot. How much will 18.25 feet of this steel weigh?
4. Multiply 4.1 x 8.32.

## ANSWERS TO EVALUATION

1. 3.27"
2. $18.03
3. 62.05 pounds
4. 34.112

## ANSWERS TO APPLICATIONS

1. $91.35
2. $92.30
3. $134.55
4. 3,976.325 pounds or 3,976.3 lbs.
5. 24.9936 lbs. or 24.99 lbs.
6. $248.44
7. 205.5625" or 205.56"
8. 0.26918"
9. 3329.625
10. 18.8496"
11. $0.198 or $0.20

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #25

Performance Objective #25: Given two decimal numbers, find the product.

1. Find the cost of 21 bags of mortar mix at $4.35 a bag.

2. A bricklayer purchased 85 eight-inch blocks at 65¢ each and 65 four-inch blocks at 57¢ each. What was the amount of the bricklayer's bill?

3. Find the cost of 13 tons of sand at $10.35 per ton.

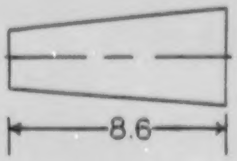
4. What is the weight of 1,500.5 sq. ft. of flooring if the weight per sq. ft. is 2.65 pounds?

5. The weight of 1/4" plate glass is 3.28 lbs. per sq. ft. What is the weight of a piece of 1/4" plate glass at 7.62 sq. ft.?

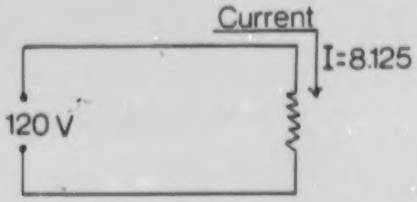
6. A carpenter works for $6.25 per hour. During one week he worked 39.75 hours. How much did he earn? (Round off to nearest cent.)

7. A roof has a 1/4 pitch. The length of common rafters per foot of run for the roof is 12.65". What is the length of a common rafter if the run is 16.25 inches?

8. The taper per inch in the gage shown in the drawing below is .0313". Find the total taper in the gage.

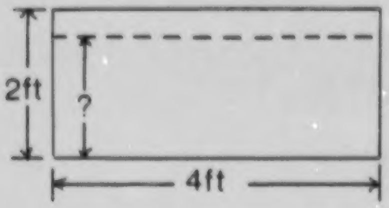


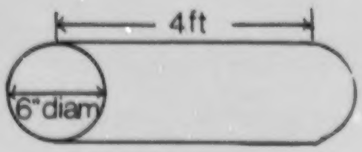
9. Electrical energy may be converted into heat energy by multiplying voltage times current times a constant of 3.415. How much heat energy will the heater in the diagram produce?



Heat = Volts x Current x 3.415

10. A round pipe is to be made from a piece of flat sheet metal. The pipe will be 4 feet long and 6 inches in diameter.





The circumference of a circle is the diameter x 3.1416. The circumference of the pipe is __________?

11. How much will it cost to operate an electric heater if the heater uses 0.45 KW of power per hour and is on 8 hours. The cost is $0.055 per each KWH.

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Add, subtract, multiply and divide decimals.

## PERFORMANCE OBJECTIVE #26

Given two decimal numbers, find the quotient.

## SAMPLE ITEM

If an automobile travels 375.4 miles in 6.25 hours, what is its average rate in miles per hour? (ans: 60.1 mph)

## REFERENCE TO TEXT

Applied General Mathematics (AGM), pages 165-175

## EVALUATION

1. A truck was hauling 6,200 pounds of steel. How many tons is this? (1 ton = 2,000 lbs.)
2. A mechanic worked 40.5 hours last week and made $212.63. What is the hourly rate?
3. An airplane propeller 4.25" thick is made of 5 layers of uniformly thick laminating material. What is the thickness of each layer of material?
4. $146.2 \div 0.043 = ?$

## ANSWERS TO EVALUATION

1. 3.1 tons
2. $5.25 per hour
3. 0.85"
4. 3,400

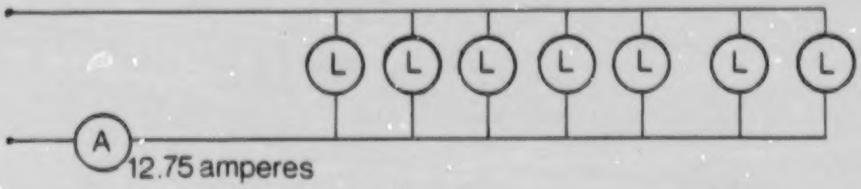
## ANSWERS TO APPLICATIONS

1. 36.75 hrs.
2. $2.75 per hour
3. 40 pieces
4. 125 pieces
5. $1.61 per pound
6. 1.82 amps.
7. 7
8. $135.50
9. $6.10
10. $10.35

## APPLICATIONS
## FOR
## PERFORMANCE OBJECTIVE #26

Performance Objective #26: Given two decimal numbers, find the quotient.

1. A cabinetmaker earns $7.82 per hr. His/her paycheck was $287.39. How many hours did he/she work?
2. A check for $173.25 was received for 63 hours of work. What is the hourly rate?
3. How many pieces of prefinished paneling .1875" thick are there in a stack 7.5" high?
4. How many pieces of tile each 0.132" thick are there in a stack 16.50" high?
5. If R-12 refrigerant costs $48.16 for 30.0 pounds, what is the cost per pound?
6. If the lamps require a total of 12.75 amperes, how many amperes will one lamp require? All the lamps are of the same type and each requires the same number of amperes.



7. Refrigerators are being charged with refrigerant using a Dial-A-Charge cylinder. The cylinder contains 8.375 pounds at the start of the charging. Each refrigerator will have 1.125 pounds of refrigerant added. How many refrigerators can be charged?
8. A contractor figured the cost for the labor of laying 12,000 common bricks at $1,626. What was the price per 1,000 bricks?
9. The total cost for pouring a 52 sq. ft. patio is $317.20. What is the cost per square foot?
10. If 11 tons of sand cost $113.85, what is the cost per ton of sand?

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Make conversions within the metric system.

## PERFORMANCE OBJECTIVE #27

Given a linear measure in metric units, write an equivalent measure using a different unit.

## SAMPLE ITEM

14 cm = ____ mm (ans. 140)

## NOTES

Conversions are made among these units: kilometer, meter, centimeter and millimeter. Refer to notes for Performance Objective # 19. Allow students to use a meter stick as a reference when making conversions.

## REFERENCE TO TEXT

**Applied General Mathematics** (AGM.), pages 291-296; 301-305
Note: Machinists must convert from the metric system to the customary system and vice versa. For this reason, the teacher may want to cover pages 296-301.

## EVALUATION

1. 63 mm = ____ cm
2. 45 cm = ____ mm
3. 38 mm = ____ m
4. 56 cm = ____ m
5. 4 m = ____ cm

## ANSWERS TO EVALUATION

1. 6.3
2. 450
3. 0.038
4. 0.96
5. 400

## ANSWERS TO APPLICATIONS

1. 0.00253 m
2. .0439 m
3. 61.7 cm
4. 9890 cm
5. 0.012 km
6. 730 cm
7. 1.75 m
8. 7.6 cm
9. 365 mm
10. 3,800 m
11. 11.8 cm x 20.5 cm
12. 126.4 m
13. 3,500 m

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #27

Performance Objective #27: Given a linear measure in metric units, write an equivalent measure using a different unit.

Conversions

1. 0.253 cm = ________ m
2. 43.9 mm = ________ m
3. .617 m = ________ cm
4. 98.9 m = ________ cm
5. 12 m = ________ km
6. 7.3 m = ________ cm
7. 175 cm = ________ m
8. 76 mm = ________ cm
9. 36.5 cm = ________ mm
10. 3.8 km = ________ m

Given:
10 millimeters (mm) = 1 centimeter (cm)
10 cm = 1 decimeter (dm)
10 dm = 1 meter (m)
1000 m = 1 kilometer (km)

11. A switch box measures 118 mm by 205 mm. What are the dimensions in centimeters?

12. An electrical cable is to be placed between two buildings which are 120 meters aparts. The cable will be pulled inside each building 32 decimeters. What will be the total cable needed in meters?

13. Pipe was laid in a ditch which was 3.5 kilometers long. How many meters would this be?

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# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Find the perimeter of a polygon using metric units.

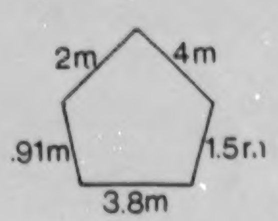
## PERFORMANCE OBJECTIVE #28

Given a polygon with dimensions in metric units, find the perimeter.

## SAMPLE ITEM

Find the perimeter.

(ans 12.21 m)



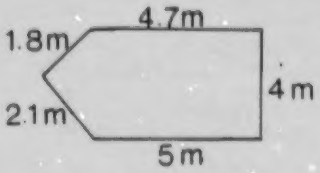
## NOTES

Have students measure actual pieces of metal, the room or marked off areas in the school yard to get the necessary dimensions to compute the perimeter.

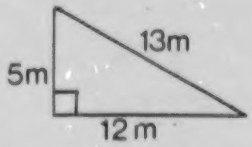
## EVALUATION

1. Find the perimeter of a rectangle with dimensions 8 meters by 12 meters.

2. How many meters of landscaping timbers are needed to border this flower garden?



3. Find the perimeter.



4. How many meters of baseboard are needed for a room that is 3.8 m by 4.3 m?

## ANSWERS TO EVALUATION

1. 40 m
2. 17.6 m
3. 30 m
4. 16.2 m

## ANSWERS TO APPLICATIONS

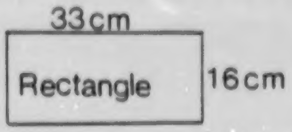
1. 98 cm
2. 336 mm
3. 34 m
4. 147 m
5. 21.76 m
6. 65.8 m
7. 12.6 m
8. a) 12 cm
   b) 12 cm
   c) 17 cm

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #28

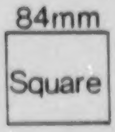
Performance Objective #28: Given a polygon with dimensions in metric units, find the perimeter.

The perimeter of a polygon is the sum of the lengths of the sides. Find the perimeter of the following polygons.

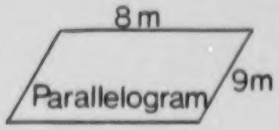
1.


33cm
Rectangle
16cm

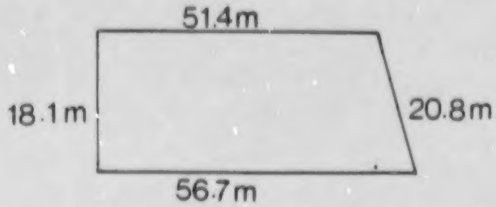
2.


84mm
Square

3.


8m
9m
Parallelogram

4. How many meters of fence are needed to enclose this lot?


51.4m
18.1m
20.8m
56.7m

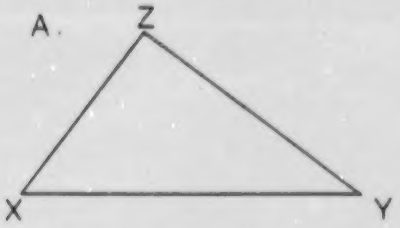
5. How many meters of ceiling molding are needed to go around a room that is 4.7 m x 6.18 m?

6. What is the perimeter of a house that is 15.8 m by 17.1 m?

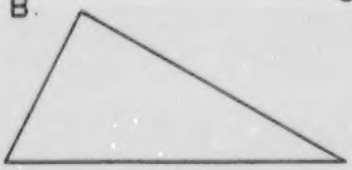
7. How many meters of carpet binding are needed for a rug that is 2.8 m by 3.5 m?

8. Measure the figures and give their perimeter in centimeters.

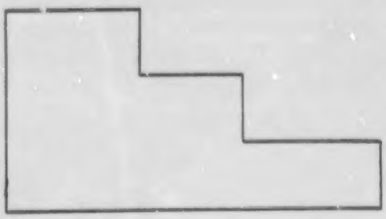
A.



B.



C.



# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Explain and use tolerance.

## PERFORMANCE OBJECTIVE #29

Given a measurement in metric or customary units and the tolerance, state the acceptable measures.

## SAMPLE ITEM

Find the upper and lower limits for these basic measurements and stated tolerances.

1. $3\frac{1}{2}" \begin{smallmatrix}+\\-\end{smallmatrix} \frac{1}{16}"$ (Ans: $3\frac{9}{16}"$, $3\frac{7}{16}"$)

2. 6.81 cm + 0.01 cm
   - 0.02 cm (Ans: 6.82 cm, 6.79 cm)

## NOTES

When fabricating items, placing equipment, filling containers etc., a tolerance is many times specified. This tolerance is established so that the item will fit or operate properly.

Tolerance is the amount by which the final measurement may vary from the basic or exact required measurement. Tolerances are expressed as plus (+) or minus (-). By adding or subtracting the plus and minus tolerances and the required measurement, the upper and lower limits of measurements are formed. The difference between the upper limit or maximum dimension and the lower limit or minimum dimension is the tolerance.

## EVALUATION

Find the dimension limits for each of the following required measurements and stated tolerances.

1. $16\frac{3}{8}" \pm \frac{1}{16}"$

2. $5\frac{1}{4}" \pm 0.015"$

3. 41.63 cm ± 0.2 mm

4. 83 mm ± 0.5 mm

## ANSWERS TO EVALUATION

1. $16\frac{5}{16}$"
2. 5.265", 5.235"
3. 41.65 cm, 41.61 cm
4. 83.5 mm, 82.5 mm

## ANSWERS TO APPLICATIONS

1.

| | Maximum | Minimum |
|---|---|---|
| a) | $10\frac{1}{8}$" | $9\frac{7}{8}$" |
| b) | $8\frac{3}{8}$" | $8\frac{1}{8}$" |
| c) | 85° 5' | 84° 55' |
| d) | 110° 30' | 103° 30' |

2. Yes
   1.815 - 1.817 - 1.825
3. 53.97 mm; 53.90 mm
4. 0.732" - 0.740"
5. Max: 3 lbs. 2 oz.
   Min: 2 lbs. 12 oz.
6. Max: $2\frac{5}{16}$"

   Min: $2\frac{3}{16}$"
7. Max: 86 ft. lbs.
   Min: 78 ft. lbs.

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #29

Performance Objective #29: Given a measurement in metric or customary units and the tolerance, state the acceptable measures.

1. What are the maximum and minimum sizes for the dimensions shown below?

| | Dimension | Tolerance |
|---|---|---|
| a) | 10" | ± 1/8" |
| b) | 8 1/4" | ± 1/8' |
| c) | 85° | ± 5' |
| d) | 107° | ± 3° 30' |

2. A hole is to be drilled 1.82 cm ± 0.005 cm. After drilling, the machinist measures and finds that the hole is 1.817 cm. Is this acceptable? Explain.

3. Measurements for a shaft are given as 53.97 mm $^{+\,0.00\text{ mm}}_{-\,0.07\text{ mm.}}$
What are the maximum and minimum measures allowed?

4. A shaft diameter is given as 0.736" ± 0.004. What is the acceptable measure range?

5. An air conditioner is to be charged with refrigerant. The tolerance is plus or minus 3 oz. The quantity stated on the data plate is 2 lbs. 15 oz. What is the maximum and minimum amount that can be put in the air conditioner?

6. Drive strips are being fabricated from sheet metal. The strips are to be cut 2 1/4 inches wide plus or minus 1/16 inch. What are the maximum and minimum sizes of strips?

7. A bolt is to be tightened to 82 ft. lbs. of torque plus or minus 4 ft. lbs. What torques are acceptable?

## APPLIED VOCATIONAL MATHEMATICS

### COMPETENCY

Read metric and customary micrometers.

### PERFORMANCE OBJECTIVE #30

Given a metric or customary micrometer and an object to be measured, measure the stated dimension to the nearest thousandth of an inch or hundredth of a millimeter.

### NOTES

A micrometer is used to make precise measurements. Students must know the meaning of the increment marks on a micrometer before they can use them. (Refer to READING A MICROMETER.)

### EVALUATION

Give the measurement for each micrometer.

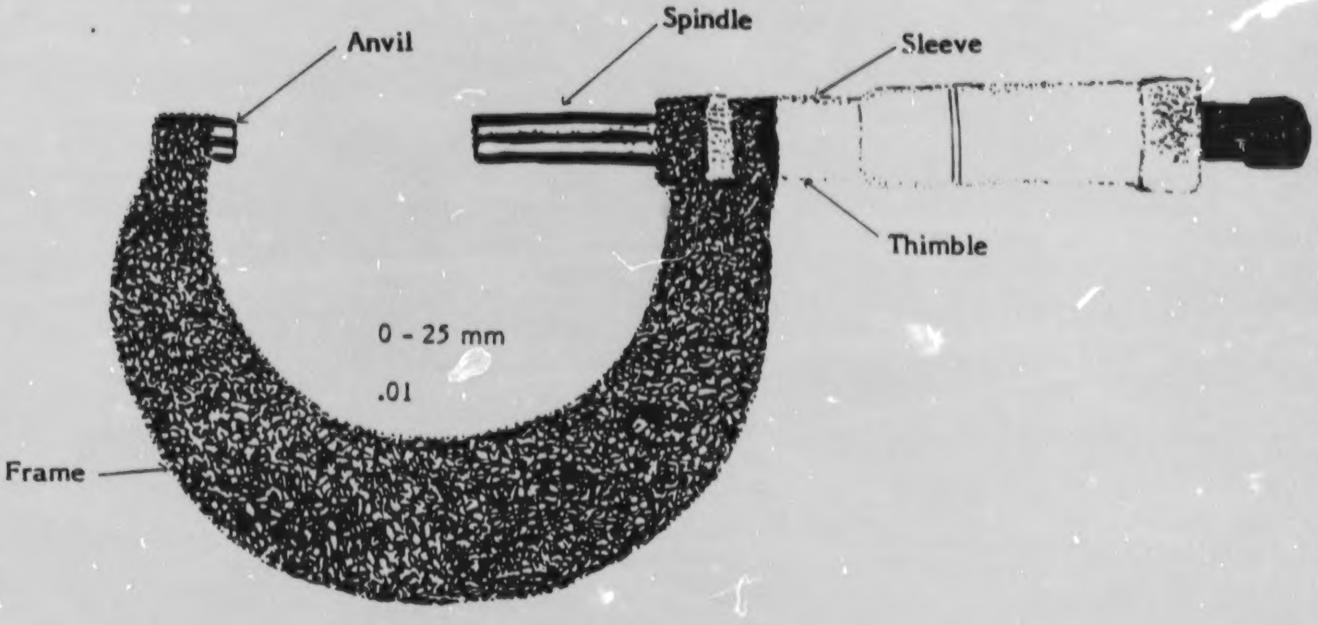
## ANSWERS TO EVALUATION

1. 13 mm
2. 34.29 mm
3. 0.526"
4. 1.344"

## ANSWERS TO APPLICATIONS

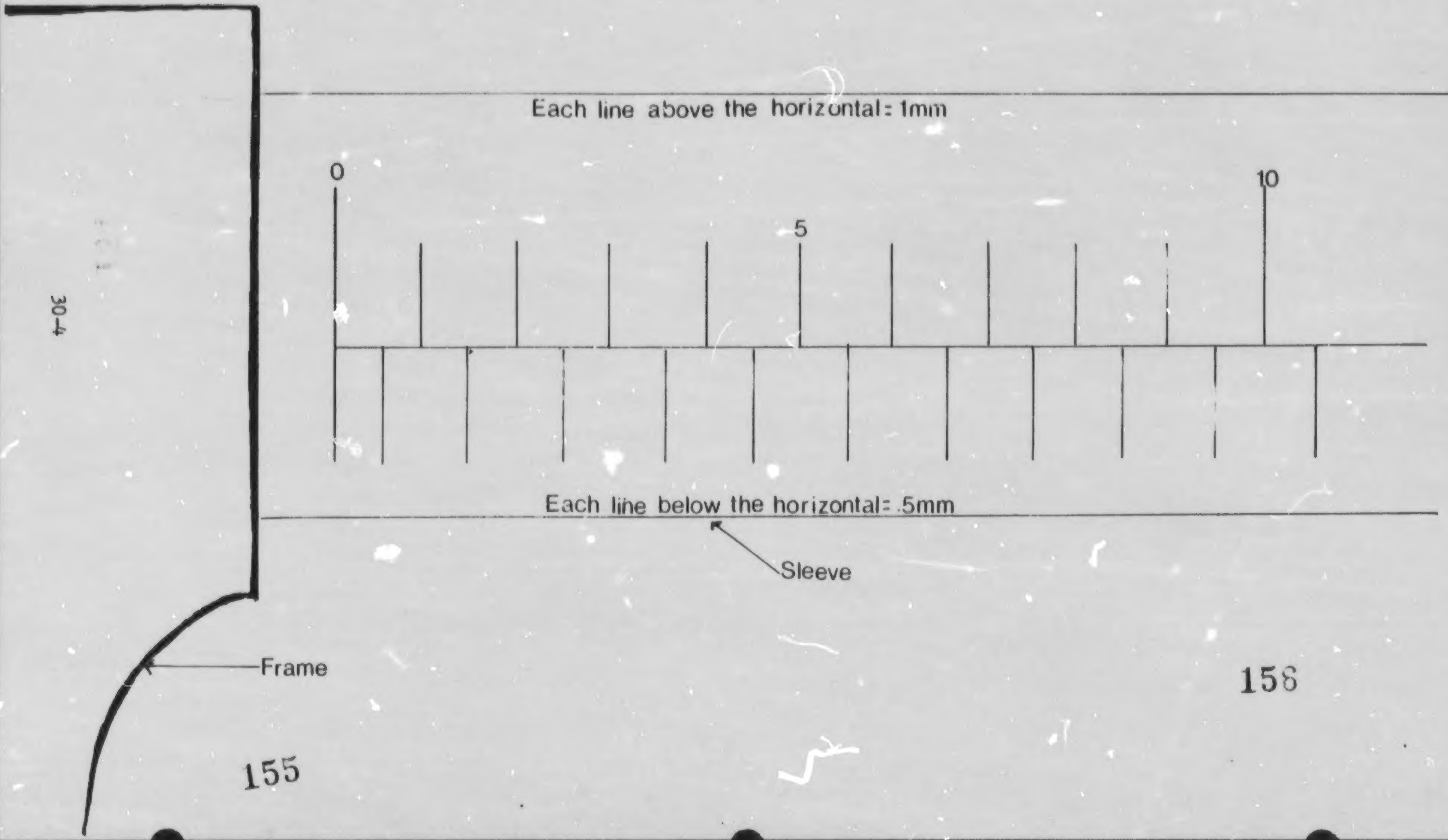
1. 0.648"
2. 0.652"
3. 0.341"
4. 0.353"
5. 0.185"
6. 16.05 mm
7. 34.28 mm
8. 20.45 mm
9. 29.50 mm
10. 4.04 mm

## READING A MICROMETER

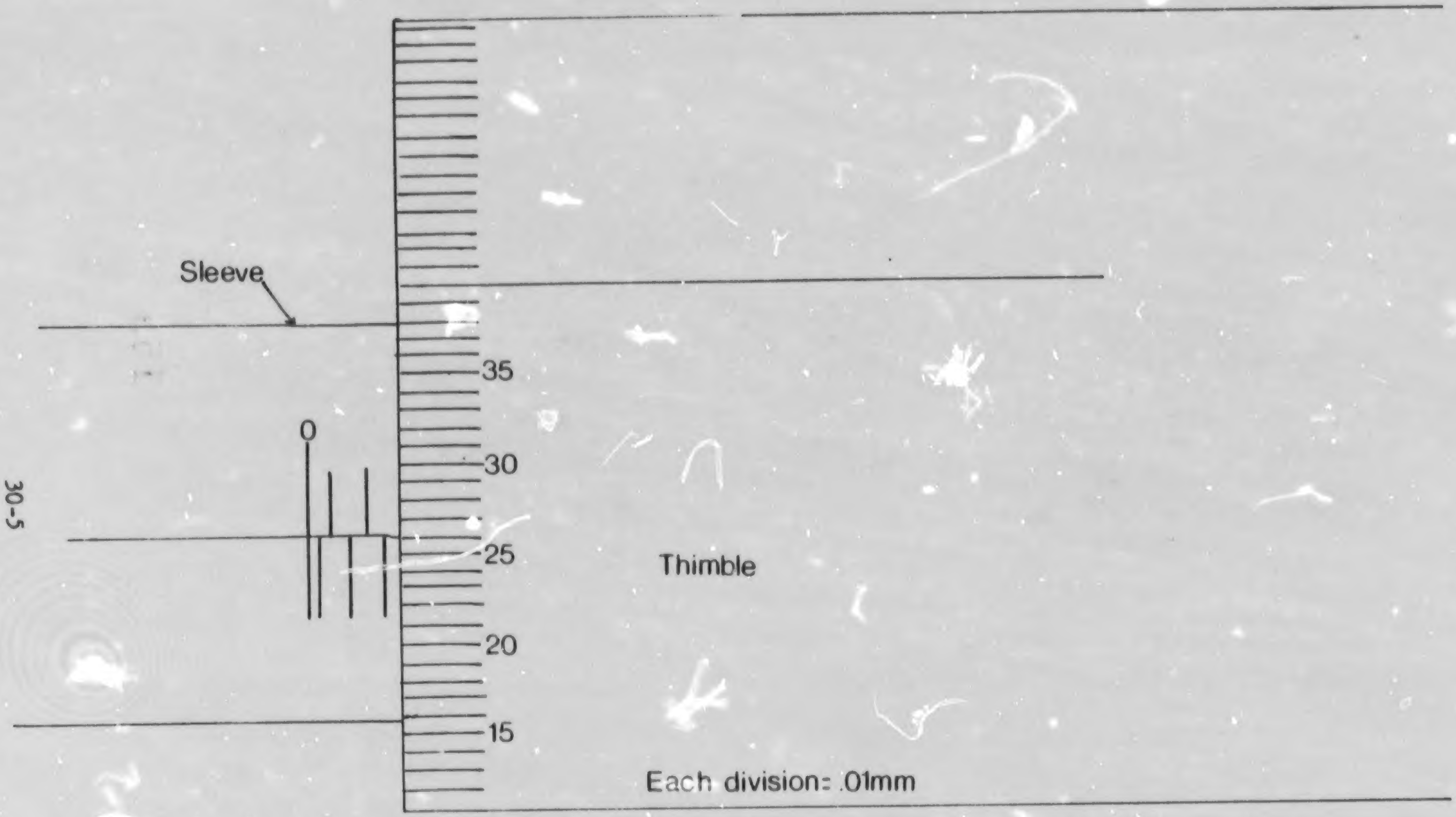

Spindle
Anvil
Sleeve
Thimble
0 - 25 mm
.01
Frame

Note: Part names are the same as the inch or English system micrometer.

# READING THE METRIC MICROMETER


30-4
Each line above the horizontal: 1mm
0
5
10
Each line below the horizontal: .5mm
Sleeve
Frame

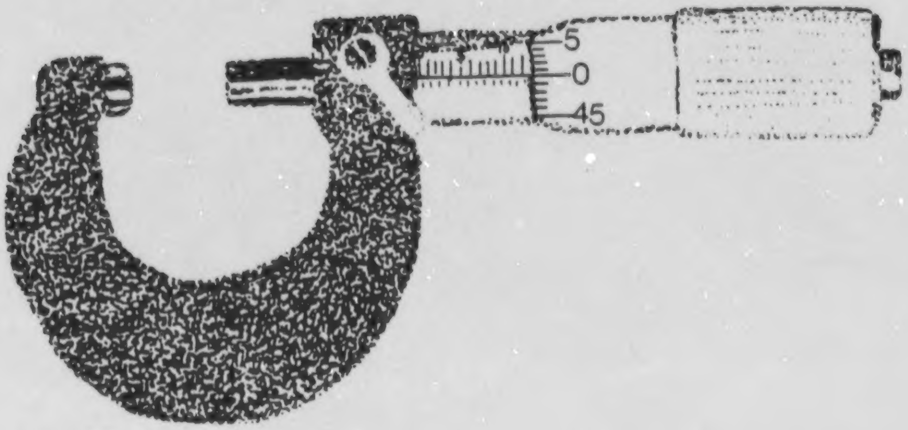
# READING THE METRIC MICROMETER


Sleeve
0
35
30
25
20
15
Thimble
Each division: .01mm

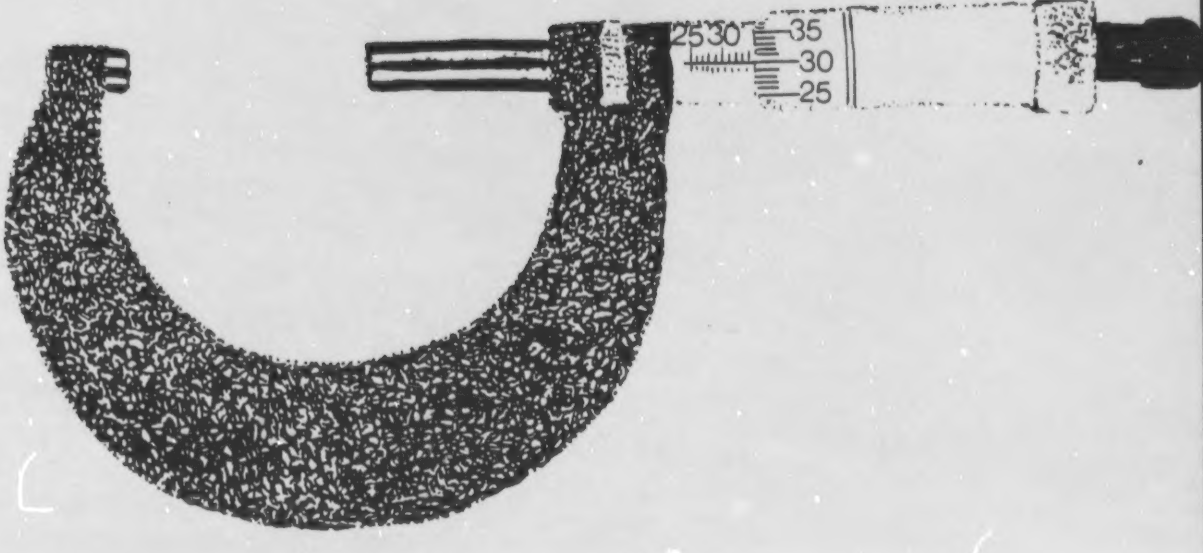
## EVALUATION

### Metric Micrometer

1.



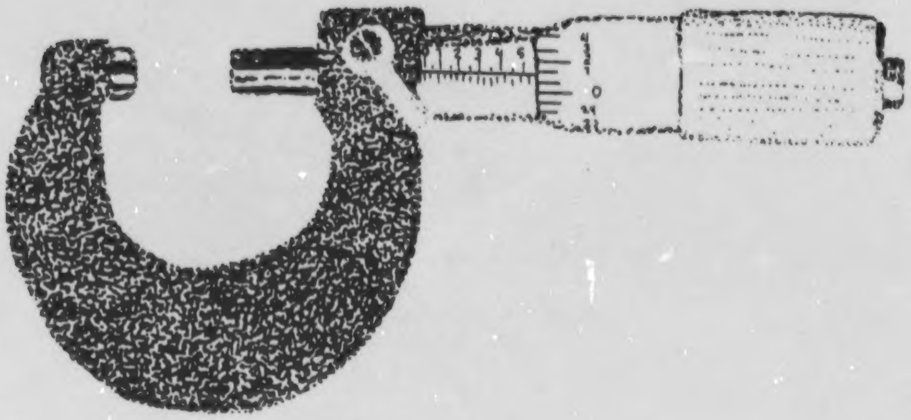
2.


25
30
35
30
25

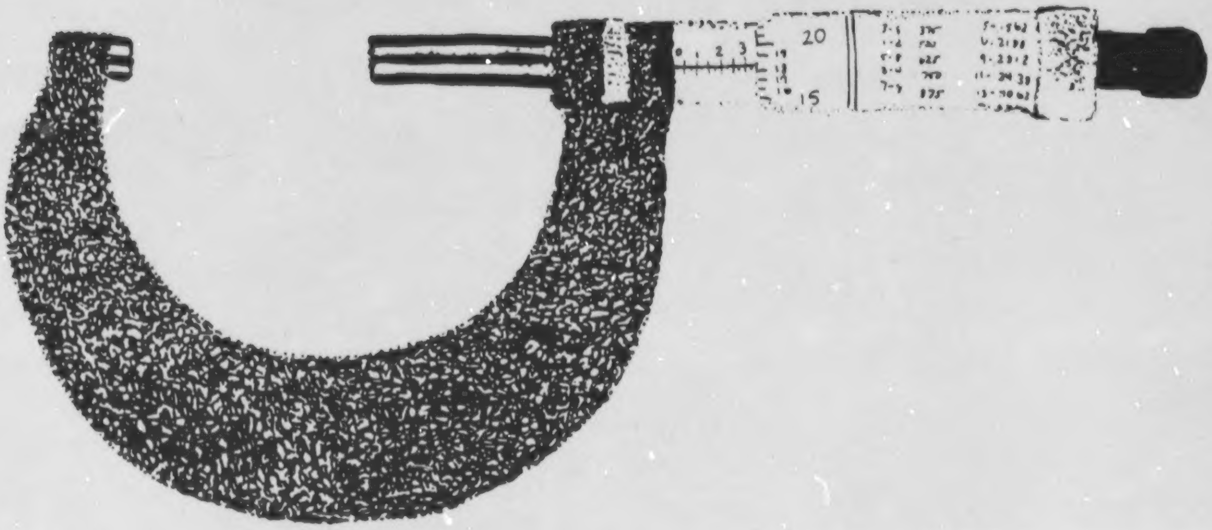
159

## English Micrometer

3.



4.

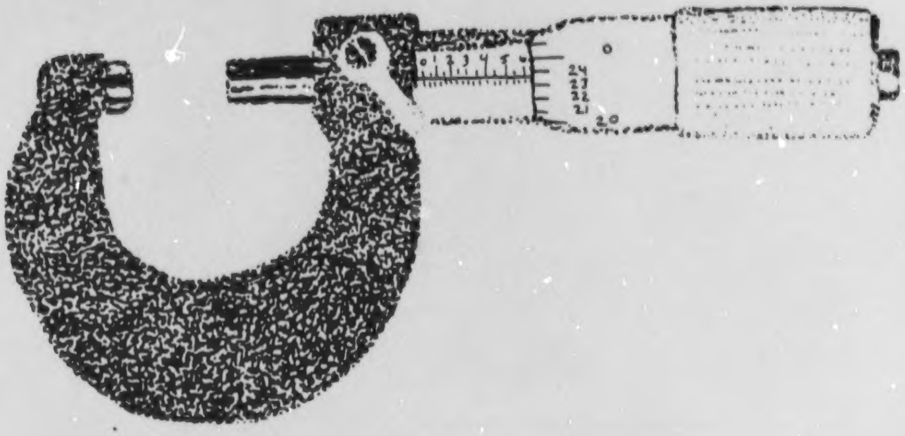


# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #30

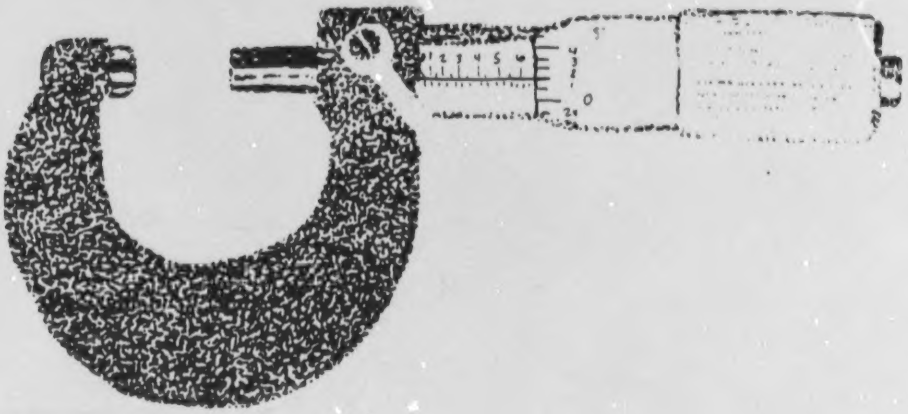
Performance Objective #30: Given a metric or customary micrometer and an object to be measured, measure the stated dimension to the nearest thousandth of an inch or hundredth of a millimeter.

## ENGLISH MICROMETER

1.


0 1 2 3 4 5 6
0
24
23
22
21
20

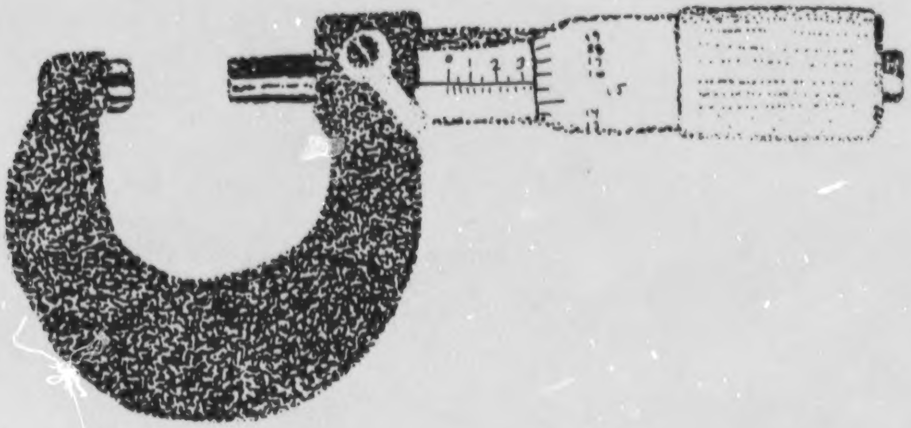
2.


1 2 3 4 5 6
5
4
3
2
1
0
24

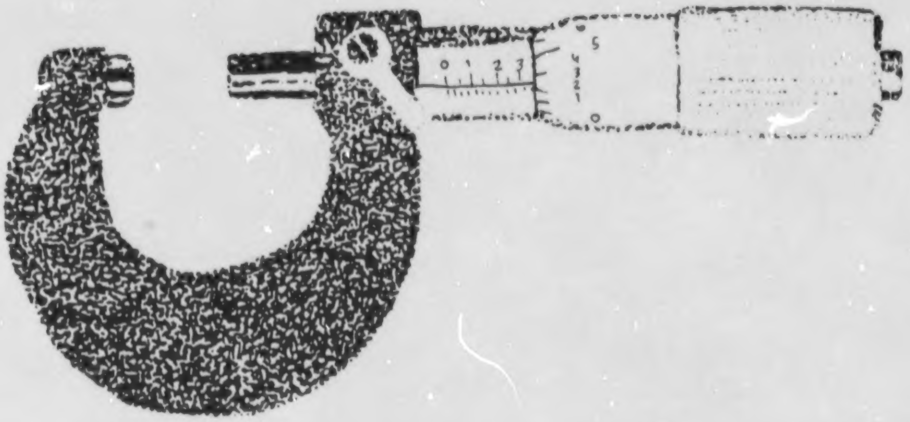
161

## ENGLISH MICROMETER

3.

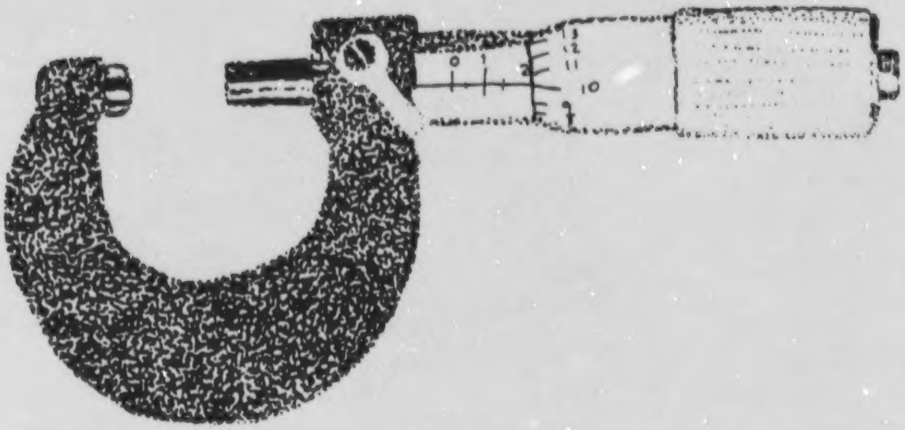

0 1 2 3
19
18
17
16
15
14

4.


0 1 2 3
5
4
3
2
1
0

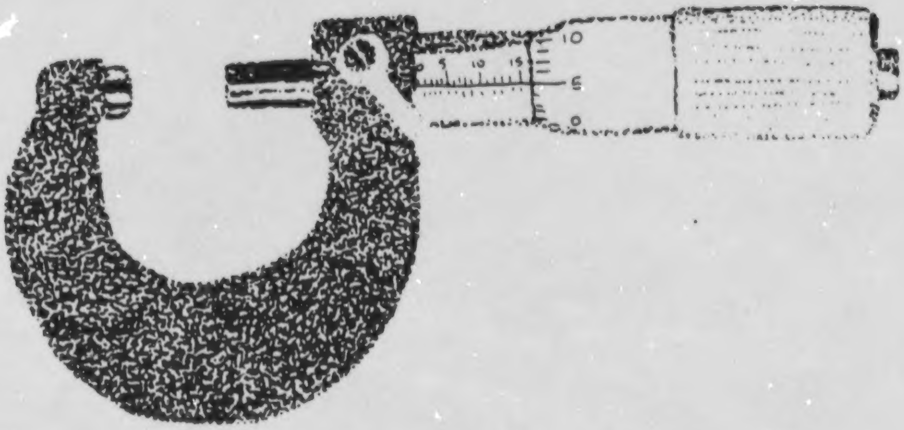
## ENGLISH MICROMETER

5.


0
1
2
13
12
11
10
9

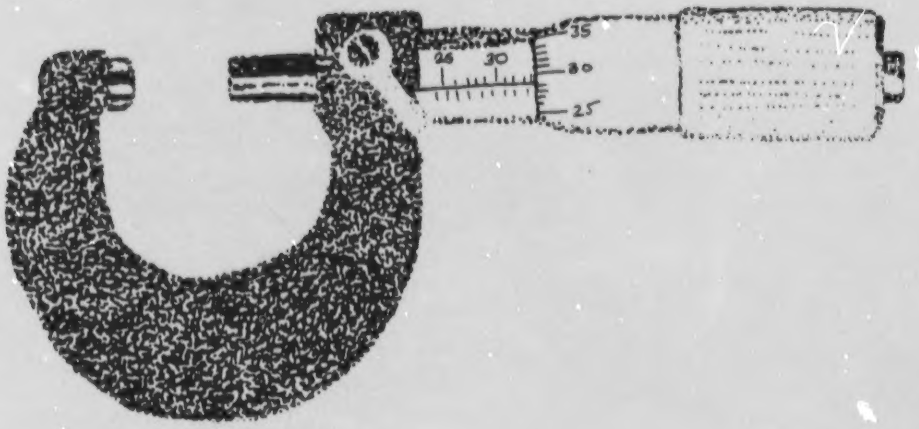
## METRIC MICROMETER

6.

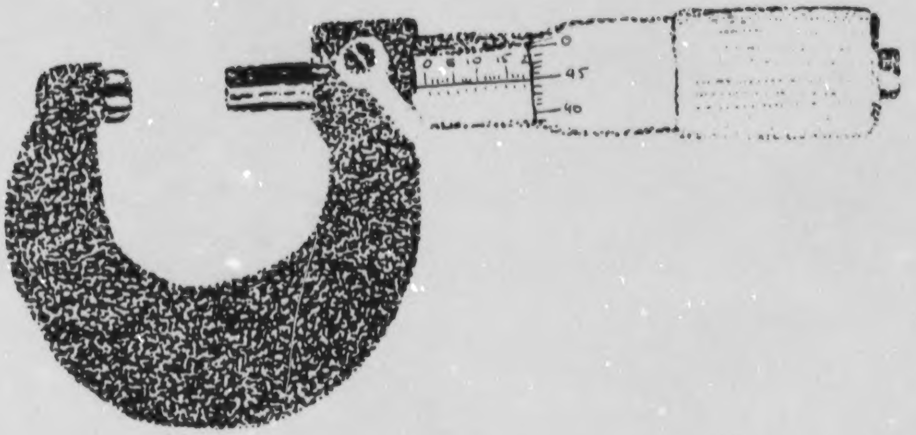

0
5
10
15
10
5
0

# METRIC MICROMETER

7.

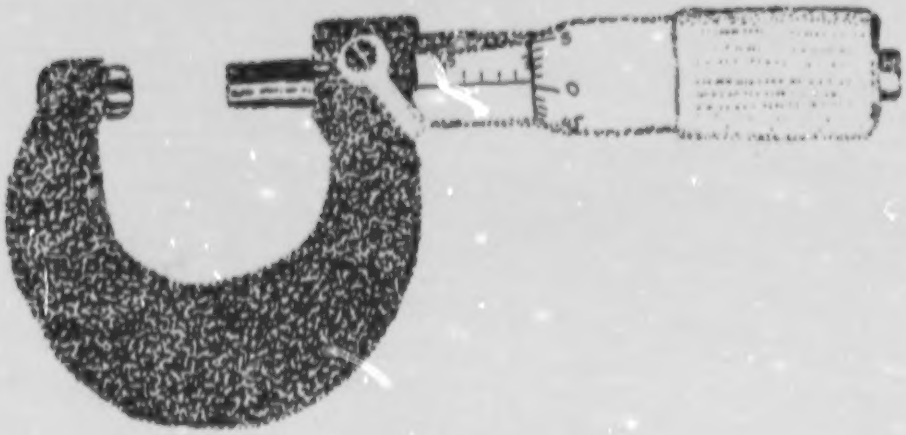

25
30
35
30
25

8.

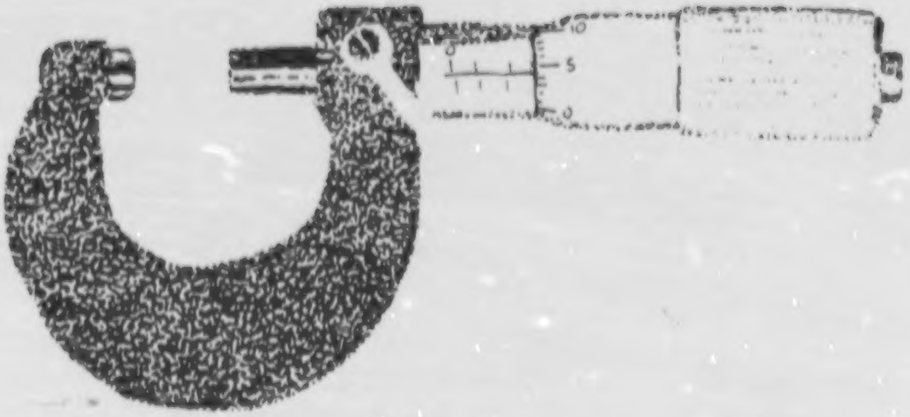

0
5
10
15
0
45
40

## METRIC MICROMETER

9.



10.



# measurement
# capacity, mass, temperature

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Measure capacity with customary units.

## PERFORMANCE OBJECTIVE #31

Given a container and a specified customary unit, determine the capacity to the nearest half-unit.

## SAMPLE ITEM

Give the student several different sizes of incremented containers and ask the student to pour 80 ounces into a bucket.

## NOTES

When working with ounces, cups, pints, quarts and gallons, the students learn best by doing actual measuring activities. Have the students estimate before they begin the actual measuring. Collect containers of different sizes and shapes, preferably containers commonly found in vocational settings.

Sometimes capacity must be calculated using a formula. In the cooling and heating trade, it is necessary to compute capacities of rooms, attics, basements and buildings. Normally, the formulas are given.

## EVALUATION

Have the student determine the capacity to the nearest half unit of four different containers.

## ANSWERS TO EVALUATION

1. a) 1,440 cu. ft.
   b) 5,760 cu. ft./hr.

2. a) 6,912 cu. in.
   b) 29.9 gal.

3. a) 9.42 cu. ft.
   b) 70.65 gal.

4. 2 cubic yards

5. 0.86 cubic yards

6. 3 feet

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #31

Performance Objective #31: Given a container and a specified customary unit, determine the capacity to the nearest half-unit.

1. A room is 15 feet wide, 12 feet long and has a ceiling of 8 feet. It is necessary to change the air 4 times each hour. a) What is the volume of the room in cubic feet? b) How many cubic feet will be moved each hour?

   Given: Volume = LxWxH

2. A condensate drain pan on an air conditioner is 48 inches long, 24 inches wide and 6 inches deep. a) How many cubic inches of water will the pan hold? b) How many gallons of water will this pan hold if 1 ga. equals 231 cubic inches?

   Given: V = LxWxH

   $$\text{gal.} = \frac{\text{cu. in.}}{231 \text{ cu. in./gal.}}$$

3. A fuel oil storage tank for an oil furnace measures 3 feet high and 24 inches in diameter. What is the capacity of the tank in a) cubic feet and b) gallons?

   Given: $V = \text{area} \times \text{height}$
   $= \pi r^2 \times h$

   1 cu. ft. = 7.5 gal.

   $$r = \frac{D}{2}$$

4. If a cement finisher is pouring a sidewalk which is 4 inches deep, 3 feet wide and 18 feet long, how much cement will he/she use (give answer in cubic yards)?

5. If a cement finisher is pouring a sidewalk which is 4 inches deep, 3 feet 6 inches wide and 20 feet long, how much cement will he/she use (give answer in cubic yards)?

6. The sheet metal worker was asked to make a container to hold 27 cubic feet. If the container must fit in a floorspace only 3 feet square, how high should he/she make the container?

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Measure capacity with metric units.

## PERFORMANCE OBJECTIVE # 32

Given a container and specified metric unit, determine the capacity to the nearest half-unit.

## SAMPLE ITEM

Give the student several different sizes of metrically marked containers and ask the student to pour 1.6 liters into a bucket.

## NOTES

As with customary units, the students learn the units as they estimate and measure. Provide many opportunities for actual measuring.

Note that cubic measures are written with exponents in the metric system. (ex: $cm^3$)

## EVALUATION

Have the student determine the capacity to the nearest half-unit of four different containers.

## ANSWERS TO APPLICATIONS

1. a) 233,856 $cm^3$
   b) 0.233 $m^3$

2. a) 110,715 $cm^3$
   b) 110.7 liters

3. a) 779,976 $cm^3$
   b) 779.98 or 780 liters

4. 1.5 $m^3$

5. 23.76 $m^3$

6. 3.33 cm

7. 5,203.733 cu. ft. = 39,028 gallons

8. 446.638 or 447 gals.

9. 124.666 or 124 1/2 cubic yards

10. 1.47 or 1.5 cubic yards

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #32

Performance Objective #32: Given a container and specified metric unit, determine the capacity to the nearest half-unit.

1. A refrigerator measures 48 cm wide, 116 cm high, and 42 cm deep. a) What is the capacity in cubic centimetres? b) in cubic metres?

   Given: V = LxWxH
   $1\ m^3 = 1{,}000{,}000\ cm^3$

2. A condensate drain pan on an air conditioner is 121 cm long, 61 cm wide and 15 cm deep. a) How many $cm^3$ of water will the pan hold? b) How many litres (L) will this pan hold if 1 litre equals $1{,}000\ cm^3$?

3. A fuel oil storage tank measures 276 cm high and 60 cm in diameter: What is the capacity of the tank in a) $cm^3$? b) litres?

   Given: $1{,}000\ cm^3 = 1$ litre
   $V = \pi r^2 \times h$

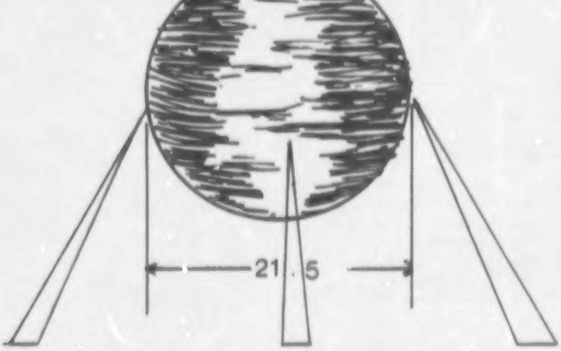
4. If a cement finisher is pouring a sidewalk which is .1 meter deep, 1 meter wide and 15 meters long, how much cement will he/she use?

5. If a mason is pouring a cement footing which is .3 meters deep, .5 meters wide and 158.4 meters long, how much cement will he/she use?

6. The glassblower was asked to make a special bottle to hold 270 cubic centimeters. If the container must fit in a space only 9 centimeters square, how high should he/she make the container?

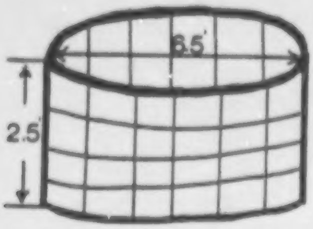
7. What is the capacity in gallons of a spherical tank whose diameter is 21.5 ft? A cubic foot contains about 7 1/2 gallons. (Answer to the nearest 1/2 gal.)

   $(V = .5236D^3)$



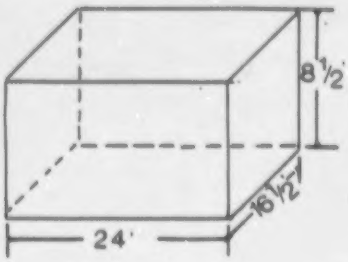
8. The James family wishes to construct a round wooden tub with a flat bottom. The size of the tub will be 6.5 ft. in diameter and 2.5 feet high. How many gallons of water will it take to fill the tub to 3/4 of its capacity? (Answer to the nearest 1/2 gallon.)

(Formula: $V = .7854D^2H$)
(Approx. 7 1/2 gallons per cubic foot)



9. Find the number of cubic yards of air in a room 24 feet long, 16 1/2 feet wide and 8 1/2 feet high. (Answer to the nearest 1/2 cubic yard.)

(27 cu. ft. = 1 cu. yd.)
($V = lwh$)



10. Determine the number of cubic yards of concrete in a column 10 feet high and 27 inches in diameter. (Change 27" to 2.25 ft.)

($V = .7854D^2 H$)

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Measure mass with customary units.

## PERFORMANCE OBJECTIVE #33

Given an item and a specified customary unit, deterine its mass to the nearest half-unit.

## SAMPLE ITEM

Determine the weight to the nearest half-ounce of a piece of metal.

## NOTES

**General:** Try to provide students with opportunities to use the different types of scales they will encounter in the vocational fields. Again, it is important that students estimate and measure the weights of various objects, preferably items such as they will encounter in their work: bricks, mortar, lumber, metal, etc.

**Heating/Air Conditioning:** Weights of substances (solids, liquids, gases) are important in the heating and cooling trade. The serviceperson needs to know the weight of air to be moved by a fan, the weight of water in a cooling tower that must be supported by a roof, or the weight of metal to be transported.

## EVALUATION

Give the student four different items to be weighed and the designated units to use.

## ANSWERS TO APPLICATIONS

1. 7,747.2 or 7,747 lbs/hr.
2. total weight 2,488 lbs; therefore, 488 lbs. overloaded
3. tower: 1,025 lbs.
   water: 3,994 lbs.
   total: 5,019 lbs.
4. 17.2 or 18 cans
5. 16,800 gallons

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #33

Performance Objective #33: Given an item and a specified customary unit, determine its mass to the nearest half-unit.

1. An air conditioning centrifugal fan is to move 1,600 CFM (cubic feet per minute) of air. How many pounds of air will be moved per hour if the weight density of air at 32°F is 0.0807 $lbs/ft^3$?

2. A truck that has a load limit of 1 ton has been loaded with the following items: condensing unit — 600 lbs, air handler — 250 lbs and a compressor — 150 lbs. Would the truck be overloaded if 62 pieces of 4 ft. x 8 ft, 26 gage sheet metal were also loaded on the truck? If yes, how much is the truck overloaded? Weight per square foot of 26-gage sheet metal is 0.75 lbs.

3. A redwood cooling tower that weighs 1,025 lbs. is to be placed on the roof of a building. The reservoir on the tower is 8 ft. long, 4 ft. wide and 2 ft. deep and will be filled with water. If the weight density of water is 62.4 $lbs/ft^3$, what will be the total weight of the tower and water? Given: Vol = L x W x H.

4. The dietetic technician needs 132 servings of juice. If juice is supplied in 46 ounce cans and each serving is 6 ounces, how many cans of juice will be needed?

5. A water tank has a volume of 5,600 cubic feet and the tank is 4/10 full. How many gallons of water are in the tank? (1 cubic foot = 7.5 gallons)

## COMPETENCY

Measure mass with metric units.

## PERFORMANCE OBJECTIVE #34

Given an item and a specified metric unit, determine its mass to the nearest half-unit.

## SAMPLE ITEM

Give the student a piece of metal to weigh to the nearest gram.

## NOTES

See Performance Objective #33. Metric weights are usually given in grams or kilograms.

## EVALUATION

Give the student four items to be weighed and the designated unit(s) for recording the masses.

## ANSWERS TO APPLICATIONS

1. 2,715.3 or 2,715 kg/hr
2. V = 1,328,848 $cm^3$
   Mass = 1,089,655 grams = 1,097 kilograms
3. V = 87,920 $cm^3$
   Mass when half full = 57,148g or about 57kg

178

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #34

Performance Objective #34: Given an item and a specified metric unit, determine its mass to the nearest half-unit.

1. A furnace fan is designed to move 35 CMM (cubic metre per minute) of air. If air at 0°C has a mass density of 1.293 $kg/m^3$, how many kilograms of air will be moved each hour?

2. An oil tank 92 cm in diameter and 200 cm in height is to be filled with fuel oil. The oil has a mass density of 0.82 $gram/cm^3$. When the tank is full of oil, how much will the oil weigh? Given $V = \pi r^2 \times h$.

3. A R-12 refrigerant drum is 40 cm in diameter and 70 cm in height. Liquid R-12 at 24°C has a mass density of 1.3 $grams/cm^3$. How much does the refrigerant weigh when the drum is half full?

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Make conversions within systems among capacity units and among mass units.

## PERFORMANCE OBJECTIVE #35

Given a customary capacity or mass measurement, write an equivalent customary measurement using a different unit.

## SAMPLE ITEMS

1 cubic foot = ______ cubic inches
1 1/2 qts. = ______ ounces
40,000 pounds = ______ tons
(ans: 144, 48, 20)

## NOTES

The service person takes technical information from blueprints, schematic drawings, installation instructions, etc. It is very often necessary to change from one unit of measure to another unit of measure. Conversion tables are available in many technical publications and textbooks.

## REFERENCE TO TEXT

**Applied General Mathematics** (AGM), pages 319-322; 330-333

## EVALUATION

Complete:

1. 82 ounces = ______ quarts
2. 37 quarts = ______ gallons
3. 5 cubic yards = ______ cubic feet
4. 3 1/2 tons = ______ pounds

## ANSWERS TO EVALUATION

1. $2\frac{9}{16}$ qts.
2. $9\frac{1}{4}$ gals.
3. 135 cubic feet
4. 7,000 pounds

## ANSWERS TO APPLICATIONS

1. 5 gallons
2. 22,000 lbs.
3. 9.5 tons
4. 18.5 cubic feet or 0.685 cubic yards or 0.69 cubic yards
5. 5,134 cubic inches
6. 87.6 pounds
7. 1 gallon 3 quarts

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #35

Performance Objective #35: Given a customary capacity or mass measurement, write an equivalent customary measurement using a different unit.

1. A bucket holds 20 quarts of water. How many gallons does it hold?
2. A dump truck arrives with 11 tons of sand. How many pounds of sand is it carrying?
3. If a 12" block weighs 38 lbs., how many tons would 500 blocks weigh?
4. A concrete pad for a hundred-ton air conditioner is to be poured. The pad measures 12 feet 4 inches by 4 feet 6 inches by 4 inches. How many cubic feet and cubic yards of concrete will be needed?
5. A tank is being constructed to hold 22.5 gallons of liquid coil cleaner. What size tank in cubic inches should be constructed? (1 cubic foot = 7.5 gallons.)
6. Six drums of refrigerant R-22 have been weighed as follows: 28 lbs. 2 oz.; 4 lbs. 14 oz., 14 lbs. 5 oz.; 8 lbs. 9 oz.; 12 lbs. 1 oz. and 19 lbs. 11 oz. What is the total amount of refrigerant on hand in pounds to the nearest tenth?
7. How should you express 28 cups in order to prevent the cook from making counting mistakes?

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Make conversions within systems among capacity units and among mass units.

## PERFORMANCE OBJECTIVE #36

Given a metric capacity or mass measurement, write an equivalent metric measurement using a different unit.

## SAMPLE ITEMS

2.5 liters = ______ milliliters (ans.: 2,500)
456 grams = ______ kilograms (ans.: 0.456)
3,330 $cm^3$ = ______ L (ans: 3.330)

## NOTES

The service person takes technical information from blueprints, schematic drawings, installation instructions, etc. It is very often necessary to change from one unit of measure to another unit of measure. Conversion tables are available in many technical publications and text books.

## REFERENCE TO TEXT

**Applied General Mathematics** (AGM), pages 322-329; 330-340

## EVALUATION

Complete:

1. 4.2 L = ______ $cm^3$
2. 1,763 mL = ______ L
3. 5,276 g = ______ kg
4. 5.1 L = ______ mL

## ANSWERS TO EVALUATION

1. 4,200 $cm^3$
2. 1.763 L
3. 5.276 kg
4. 5,100 m

## ANSWERS TO APPLICATIONS

1. 25,000 L
2. 0.333 L
3. 4.325 kg
4. 21,800 mg
5. 677.6 hg
6. 7.568 L
7. 8.324 L
8. 2,500 $cm^3$
9. 6 hrs. 40 mins.
10. 16 servings

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #36

Performance Objective #36: Given a metric capacity or mass measurement, write an equivalent metric measurement using a different unit.

1. 25 kL = ________ L

2. 333 mL = ________ L

3. 4,325 g = ________ kg

4. 21.8g = ________ mg

5. A condensing unit weighs 111.36 kilograms. When the compressor is removed from the condensing unit, the weight is 43.6 kilograms. How much does the compressor weigh in hectograms?

6. A 2-ton compressor requires 473 milliliters (mL) of refrigerant oil. Sixteen compressors are to be filled. How much oil will be required in liters?

7. A dial-a-charge refrigerant cylinder contains 8,324 cubic centimeters ($cm^3$). Convert this capacity to liters.

8. How many cubic centimeters are contained in a 2.5 liter engine?

9. If an empty fuel tanker has a volume of 20,000 liters, and oil is pumped into the tanker at a rate of 50 liters per minute, how long would it take to fill the tank?

10. How many 250 mL servings of punch can be served from 4L?

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Read Fahrenheit and Celsius thermometers.

## PERFORMANCE OBJECTIVE #37

Given a Fahrenheit or Celsius thermometer, read the temperature to the nearest half-degree.

## NOTES

Have students measure the temperature in both Fahrenheit and Celsius of items and places such as:

1. water from hot and cold faucets.
2. water from cold water fountain.
3. room temperature in various spots.
4. dirt temperature at ground level and 6 inches down.

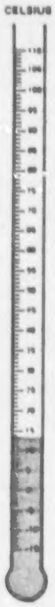
These temperatures on the Celsius scale should be memorized.

1. 0° — water freezes
2. 20-22° — comfortable room temperature
3. 37° — normal body temperature
4. 100° — water boils

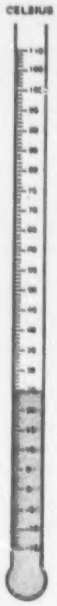
## EVALUATION

1. Read these Celsius thermometers to the nearest half-degree.

a)

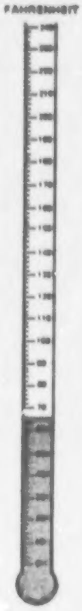


b)

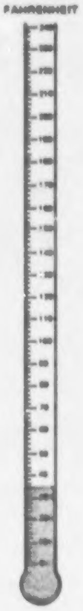


2. Read these Fahrenheit thermometers to the nearest half-degree.

a)


FAHRENHEIT

b)


FAHRENHEIT

## ANSWERS TO EVALUATION

1. a) 14°C
   b) 25.5°

2. a) 68°F
   b) 36°F

## ANSWERS TO APPLICATIONS

1. c

2. d

3. e

4. b

5. a

6. a) 24°C
   b) 8°C
   c) 37.5°C

7. a) 44°F
   b) 85°F
   c) 21°F

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #37

Performance Objective #37: Given a Fahrenheit or Celsius thermometer, read the temperature to the nearest half-degree.

1. A reading of 0° is closest to which Fahrenheit reading?
   a) 0°
   b) 10°F
   c) 32°F
   d) 100°F
   e) 212°F

2. Normal body temperature is:
   a) 0°C
   b) 20°C
   c) 22°C
   d) 37°C
   e) 98°C

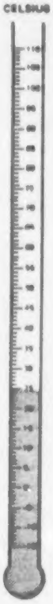
3. Water boils at:
   a) 0°F
   b) 32°F
   c) 37°F
   d) 100°F
   e) 212°F

4. Which temperature is lower?
   a) 0°C
   b) 0°F

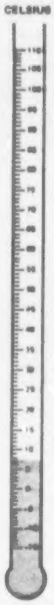
5. Which temperature is higher?
   a) 32°C
   b) 32°F

6. Give the reading on these metric thermometers to the nearest half-degree.

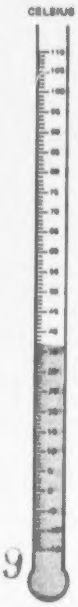
a)



b)

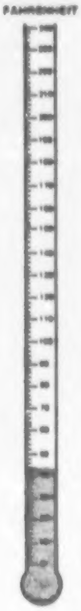


c)



7. Give the readings on these customary thermometers to the nearest whole degree.

a)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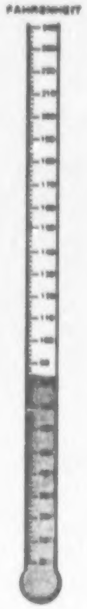
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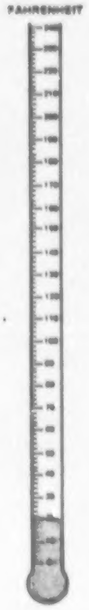
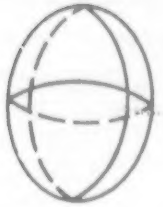
c)


FAHRENHEIT

# introduction to basic algebra



# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Solve formulas.

## PERFORMANCE OBJECTIVE #38

Given a formula and values for all but one variable, solve the formula to find the value of the remaining variable.

## SAMPLE ITEM

Find F when C is 40: $F = (9/5 \times C) + 32$
(ans: 104)

## NOTES

**General:** Although students should be required to memorize only the most commonly used formulas, learning to solve formulas is one of the most important skills encountered in a vocational math course.

**Air Conditioning/Heating:** The air conditioning and heating technician or service person must be able to use formulas to solve problems in all areas such as plumbing, sheet metal, piping, refrigeration cycle servicing, electrical and movement and control of air. Problems using formulas are solved to aid in trouble shooting and then repairing.

## REFERENCE TO TEXT

**Applied General Mathematics** (AGM), pages 43-50

## EVALUATION

1. Find D when $h = 0.25$ and $d = 5.25$: $h = \frac{D - d}{2}$
2. Find H when $P = 1.125$: $H = \frac{P}{2} + 0.01$
3. Find h when $V = 36$, $l = 6$, and $W = 2$: $V = lwh$
4. Find s when $S = 300$, $D = 10$, and $d = 2$: $\frac{s}{S} = \frac{D}{d}$

## ANSWERS TO EVALUATION

1. 5.75
2. 0.5725
3. 3
4. 1500

## ANSWERS TO APPLICATIONS

1. 675 CFM
2. ${}^{R}T = 0.3$ ohms
3. 401,920 cubic in. per min.
4. $W = 12'$
5. $A = 1{,}589.625$ sq. in.
6. $h = 22$
7. 1.000"
8. $x = 4$
9. ƶ = 9.53
10. $y = 5$

## Formulas Used In the Air Conditioning Trade

A. Temperatures

$°F = (9/5 \times C) + 32$

$°C = 5/9 \times (F - 32)$

$°R = °F + 460$

$°K = °C + 273$

B. Area

$A = L \times W$

$A = \pi \times r^2$

$A = \frac{\pi \times D^2}{4}$

C. Circumference

$C = \pi \times D$

D. Volume

$V = L \times W \times H$

$V = \pi \times r^2 \times L$

$V = \frac{\pi \times D^2 \times L}{4}$

E. Compressor Displacement (CD)

$CD = \pi \times r^2 \times L \times M \times N$

M = No. of Cylinders

N = Speed in RPM

L = Length of Strope

r = radius of cylinder

F. Boyle's Gas Law

$P_1V_1 = P_2V_2$

$P_1 = \frac{P_2V_2}{V_1}$ $P_2 = \frac{P_1V_1}{V_2}$

$V_1 = \frac{P_2V_2}{P_1}$ $V_2 = \frac{P_1V_1}{P_2}$

G. Charle's Gas Law

$P_1T_2 = P_2T_1$

(Rewrite to solve for each unknown when other 3 variables are known.)

e.g.: $P_1 = \frac{P_2T_1}{T_2}$

$T_2 = \frac{P_2T_1}{Pi}$

$V_1T_1 = V_2T_1$

(Rewrite to solve for each unknown when other 3 variables are known.)

H. Combined Gas Law

(Derived to solve for 1 unknown when other 5 are known.)

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

I. Perfect Gas Law

$PV = WRT$

J. Pressure and Force

$P = \frac{F}{A}$

K. Compression Ratio (CR)

$CR = \frac{\text{Head Pressure (PSIA)}}{\text{Suction Pressure (PSIA)}}$

L. Density (D)

$D = \frac{W}{V}$

M. Specific Volume (SV)

$SV = \frac{V}{W}$ $D = \frac{1}{SV}$

N. Specific Gravity (SG)

$SG = \frac{W_s \text{(Weight of Substance)}}{W_w \text{(Weight of Water)}}$

O. Air Flow

$$\text{CFM} = \frac{\text{q (Sensible Heat)}}{\text{1.08 x TD (Temp Difference)}}$$

$$\text{A (Area of Duct)} = \frac{\text{CFM}}{\text{V (Velocity)}}$$

$$\text{N (Air Changes per Hour)} = \frac{\text{60 x CFM}}{\text{V (Space Volume)}}$$

P. Fan Speed (S)

$$\text{S(RPM)} = \text{Speed of Motor x } \frac{\text{Dia. of Driver}}{\text{Dia. of Driver}}$$

$$S = \text{RPM} \times \frac{D_1}{D_2}$$

Q. Heat

$q = W \times SH \times TD$

$q = BTU$

SH = Specific Heat

TD = Temp. Difference

R. Power (P)

$$P = \frac{F \times D}{T} = \frac{\text{Force x Distance}}{\text{Time}}$$

$$\text{HP} = \frac{\text{Wt. in lbs. x Distance in feet}}{\text{Time in Minutes x 33,000}}$$

S. Pressure in Duct

$$P_T = P_V + P_S$$

$$V = 1{,}096 \sqrt{P_v \times v}$$

$$P_V = \left(\frac{V}{4005}\right)^2$$

$$V = 4{,}005 \sqrt{P_v}$$

## T. Electrical

Use the attached Pire Wheel to develop these formulas.

### Ohms Law and Watts Law

$P = EI$ $\quad P = I^2R$ $\quad P = E^2/R$

$I = E/R$ $\quad I = P/E$ $\quad I = \sqrt{P/R}$

$R = E/I$ $\quad R = E^2/P$ $\quad R = P/I^2$

$E = P/I$ $\quad E = \sqrt{PR}$ $\quad E = IR$

$I_T = I_1 + I_2 + I_3 \ldots$

$E_T = E_1 + E_2 + E_3 \ldots$

$R_T = R_1 + R_2 + R_3 \ldots$

$P_T = P_1 + P_2 + P_3 \ldots$

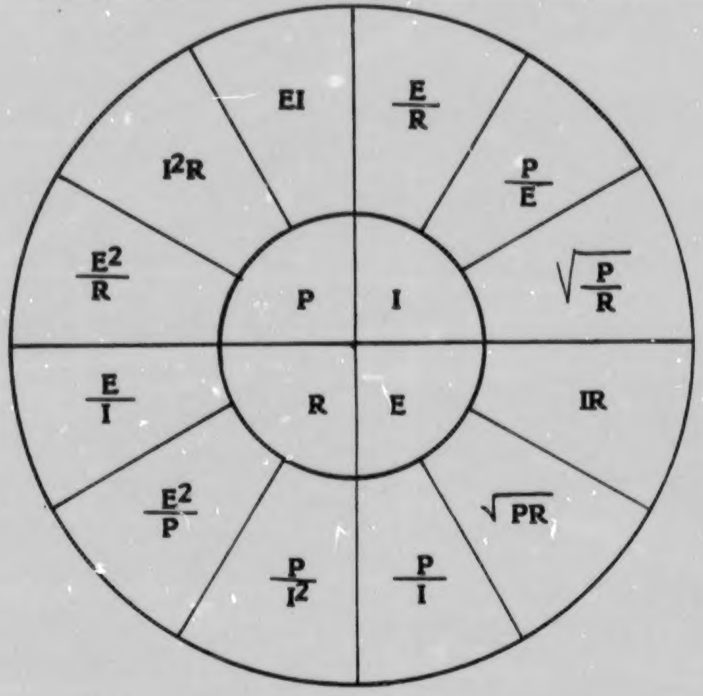
$P = E \times I \times PF$

$$R_T = \frac{R_1 + R_2}{R_1 \times R_2}$$

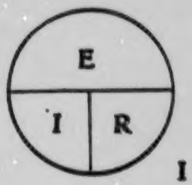
$$R_T = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$$

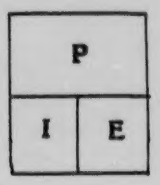
$$C_T = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}}$$

# OHMS LAWS WATTS



P
I
R
E
EI
$\frac{E}{R}$
$\frac{P}{E}$
$\sqrt{\frac{P}{R}}$
IR
$\sqrt{PR}$
$\frac{P}{I}$
$\frac{P}{I^2}$
$\frac{E^2}{P}$
$\frac{E}{I}$
$\frac{E^2}{R}$
$I^2R$





I = CURRENT IN AMPERES
E = VOLTAGE IN VOLTS
R = RESISTANCE IN OHMS
P = POWER IN WATTS

PIRE WHEEL

A device which shows the formula resulting from the combination of Ohm's Law and Watt's Law.

## APPLICATIONS
## FOR
## PERFORMANCE OBJECTIVE #38

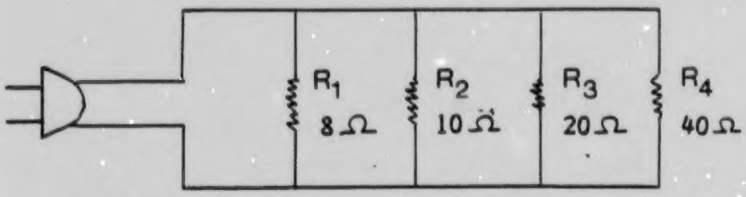
Performance Objective #38: Given a formula and values for all but one variable, solve the formula to find the value of the remaining variable.

1. A supply grill measures 30 inches by 6 inches with 90% free area. The velocity across the grill is 600 FPM (feet per minute). What is the volume of air in CFM (cubic feet per minute)?

   Given: $CFM = \frac{A \times V}{144}$

   A = area (sq. in.)
   V = Velocity FPM
   144 sq. in./sq. ft.

2. Calculate the total resistance ($R_T$) of the following diagram.



$$R_T = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}}$$

3. A compressor has four cylinders. Each cylinder has a 4-inch bore and a 4-inch stroke and the speed is 2,000 RPM. What is the displacement?

   $CD = \pi \times r^2 \times L \times M \times N$
   where
   r = radius of cylinder
   L = length of stroke
   M = no. of cylinders
   N = speed in RPM

Solve for the indicated variable.

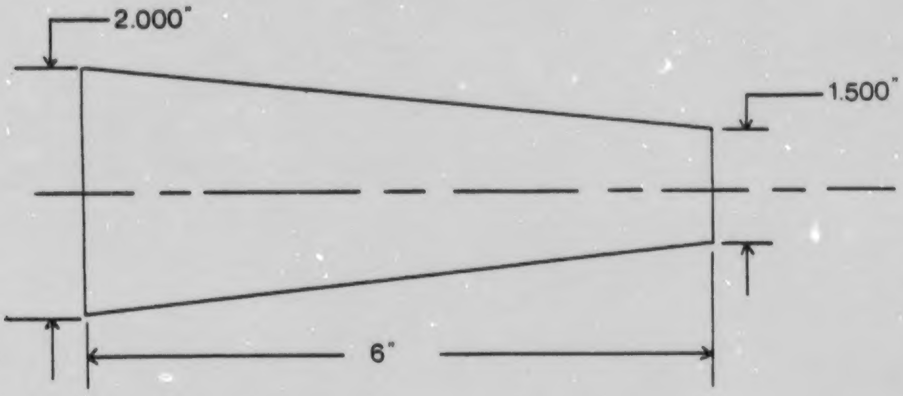
4. If $P = 2L + 2W$ and $P = 96'$; $L = 36'$ — find W.

5. If $A = \pi R^2$ and $\pi = 3.14$; $R = 22.5''$ — find A.

6. If $V = lwh$ and $V = 4{,}224$; $l = 16$; $w = 12$ — find h.

7. The machinist must determine the taper per foot by using the following formula.

$$\text{Taper per Foot} = \frac{\text{Large Dia.} - \text{Small Dia.}}{\text{Length of taper}} \times 12$$



8. $3X + 4Y = 24$. If Y is 3, then what is the value of X?

9. $5.3X + 2.9Y - 5.7Z = 100$. If X is 22 and Y is 13, then what is the value of Z?

10. $\frac{2.5x}{5y} = 1$

If $x = 10$, what is y?

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Explain meaning of signed numbers.

## PERFORMANCE OBJECTIVE #39

Given a list of positive and negative numbers and a list of interpretations, match the number to the meaning.

## SAMPLE ITEM

Match:

1. -1     a) a gain of one yard
2. +1     b) a loss of one yard

(ans. 1.b 2.a)

## NOTES

Although operations with signed numbers are not used very often in the trades and industries, the meaning of signed numbers is quite important.

## EVALUATION

Match:

1. -2     a) a gain of two

2. +2     b) a loss of three

3. -3     c) down 2

4. +3     d) up three

## ANSWERS TO EVALUATION

1. c
2. a
3. b
4. d

## ANSWERS TO APPLICATIONS

1. + 12 mph
2. - $0.40
3. - $24,500
4. - 13.5v
5. + 0.8%
6. + 15 km
7. + 18 lbs. psi
8. - 15 yds.
9. + 250 ft.
10. - 3/8

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #39

Performance Objective #39: Given a list of positive and negative numbers and a list of interpretations, match the number to the meaning.

Express these as a signed number.

1. A speed increase of 12 mph
2. A salary decrease of $0.40 per hour
3. A company's liabilities of $24,500
4. A circuit voltage loss of 13.5 volts
5. A 0.8% expansion in the length of wire
6. 15 kilometers north
7. A presure increase of 18 pounds per square inch
8. A loss of 15 yards
9. 250 feet above sea level
10. The price of the stock fell 3/8

## COMPETENCY

Evaluate expressions with powers and roots.

## PERFORMANCE OBJECTIVE #40

Given an expression with an exponent or radical, write its value without an exponent or radical.

## SAMPLE ITEM

Simplify:

1. $4^2$
2. $\sqrt{25}$

(ans: (1) 16 (2) 5)

## NOTES

Radicals and exponents appear in many formulas used by vocational students. This would be a good time to continue with formula solving.

Even though students should be permitted to use the square root key on the calculator, they must know how to estimate square roots in order to check answers for reasonableness.

With tables and calculators readily available, there is little need for students to learn a long manual method of extracting roots.

Examples of formulas are:

1. $A = \pi r^2$
2. $V = \pi r^2 L$
3. $P = I^2 R$
4. $P = \frac{E^2}{R}$
5. $I = \sqrt{P/R}$
6. $V = \frac{4}{3}\pi r^3$
7. $V = s^3$
8. $a^2 + b^2 = c^2$

## REFERENCE TO TEXT

Applied General Mathematics (AGM), pages 176-192

## EVALUATION

Simplify:

1. $1.2^2$
2. $4^3$
3. $\sqrt{81}$
4. $\sqrt[3]{125}$

## ANSWERS TO EVALUATION

1. 1.44
2. 64
3. 9
4. 5

## ANSWERS TO APPLICATIONS

1. a) 25
   b) 121
   c) 225
   d) 11.56
   e) 125
   f) 343
2. a) 8
   b) 13
   c) 19
   d) 1.4
   e) 3
   f) 12
3. $V = 1500$ FPM and $P_V = 0.14$ in. of water
4. 32.3 amps
5. 870 watts

## APPLICATIONS
## FOR
## PERFORMANCE OBJECTIVE #40

Performance Objective #40: Given an expression with an exponent or radical, write its value without an exponent or radical.

1. Raise the following to the powers indicated.

   a) $5^2$

   b) $11^2$

   c) $15^2$

   d) $3.4^2$

   e) $5^3$

   f) $7^3$

2. Find these roots.

   a) $\sqrt{64}$

   b) $\sqrt{169}$

   c) $\sqrt{361}$

   d) $\sqrt{1.96}$

   e) $\sqrt[3]{27}$

   f) $\sqrt[3]{1728}$

3. 6,000 CFM of air is flowing through a 24 in. square duct. The static pressure is 0.625 inches of water column. What is the velocity pressure ($P_v$)?

   Given: $V = \frac{CFM}{A}$

   V = Velocity in feet/min.
   A = Area in sq. ft.
   CFM = Cubic feet/min.

   $$P_v = \left(\frac{V}{4005}\right)^2$$

   $P_v$ = Velocity pressure (in water column)
   V = Velocity (FPM)

4. An electric furnace uses 10,000 watts of power. The resistance of the electrical element is 9.6 ohms. What is the current flow?

Given: $I = \sqrt{\frac{P}{R}}$

I = Current
P = Power
R = Resistance

5. An outdoor unit of a heat pump is located 300 feet from the electrical distribution panel. The resistance of the wire from the panel to the outdoor unit is 0.85 ohms and the current is 32 amp. What is the power loss in the line?

Given: $P = I^2R$

I = Current
R = Power
R = Resistance

## COMPETENCY

Read and write numbers in scientific notation.

## PERFORMANCE OBJECTIVE #41

Given a list of numbers written in scientific notation and a list of numbers in expanded form, match the scientific notation expression with its expanded form.

## SAMPLE ITEM

Match:

1. $1.5 \times 10^4$ a) 0.00015

2. $1.5 \times 10^{-4}$ b) 15,000

(ans: 1.b 2.a)

## NOTES

Although scientific notation is not used in every vocational area, it is frequently encountered in technical writings and should be familiar to the student. Students must also be able to read answers on calculators when the display shows scientific notation. Give the students problems such as 999,999 x 999 or 5 ÷ 6,666,666 and ask them to explain the calculator display.

## EVALUATION

Match:

1. $2.36 \times 10^5$ a) 0.000236

2. $2.36 \times 10^{-3}$ b) 0.00236

3. $2.36 \times 10^{-4}$ c) 236,000

4. $2.36 \times 10^4$ d) 23,600

## ANSWERS TO EVALUATION

1. c
2. b
3. a
4. d

## ANSWERS TO APPLICATIONS

1. $1.5 \times 10^{-4}$
2. $4.27 \times 10^{6}$
3. $2.5 \times 10^{7}$
4. $7.25 \times 10^{-3}$
5. $4.0 \times 10^{-4}$
6. $6.7 \times 10^{4}$
7. $8.0 \times 10^{5}$
8. $5.0 \times 10^{-1}$
9. $3.02 \times 10^{-3}$
10. $4.05 \times 10^{5}$
11. a) 5
    b) 1
    c) 2
    d) 6
    e) 7
    f) 3
    g) 4

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #41

Performance Objective #41: Given a list of numbers written in scientific notation and a list of numbers in expanded form, match the scientific notation expression with its expanded form.

Write these numbers in scientific notation.

1. 0.00015 inches

2. 4,270,000 pounds

3. $25,000,000

4. 0.00725 inches

5. 0.0004 grams

6. 67,000 kilometers

7. 800,000 gallons

8. 0.5 millimeters

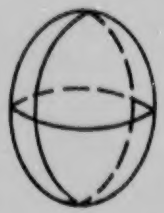
9. 0.00302 inches

10. $405,000

11. Match

| | |
|---|---|
| a) 31,000 | 1. $4.23 \times 10^6$ |
| b) 4,230,000 | 2. $4.23 \times 10^{-3}$ |
| c) .00423 | 3. $3.1 \times 10^{-2}$ |
| d) .000926 | 4. $4.23 \times 10$ |
| e) 9.260 | 5. $3.1 \times 10^4$ |
| f) .031 | 6. $9.26 \times 10^{-4}$ |
| g) 42.300 | 7. $9.26 \times 10^0$ |

# ratio, proportion and percent



# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Write and simplify ratios.

## PERFORMANCE OBJECTIVE #42

Given a verbal statement containing a ratio, write the ratio in numerical form and simplify it.

## SAMPLE ITEM

For every one part chemical, put 3 parts water. (Write the ratio of chemical to water.) (ans. 1/3)

## EVALUATION

1. A chemical costs $4.38 for 3 ounces. Write the ratio for the cost per ounce.
2. Two gears are in an 8 to 12 ratio. Write this ratio.
3. The drawing was 1.5 centimeters for every 18 meters. Write this ratio.
4. We drove 523 miles and used 13.3 gallons of gas. How many miles per gallons is this?

## ANSWERS TO EVALUATION

1. $1.46/1 oz.
2. 2/3
3. 1/12
4. 39.3 mpg

## ANSWERS TO APPLICATIONS

1. 22/1
2. 3/1
3. 6/1
4. 3/1
5. 1/125
6. 3/100
7. 2/1
8. 5/1
9. 1:4
10. 3.94 to 1

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #42

Performance Objective #42: Given a verbal statement containing a ratio, write the ratio in numerical form and simplify it.

Write the following ratios in numerical form and simplify them.

1. Two gears have 88 teeth and 4 teeth respectively.
2. A compressor has 129 cubic inches of volume at the beginning of compression and 43 cubic inches of volume after compression.
3. One pulley is running at 540 RPM and is belted to another running at 90 RPM.
4. If a laborer mixes 18 shovels of sand with 6 shovels of mortar mix, what is the ratio of sand to mortar mix?
5. A contractor finds that it takes 8 bags of mortar mix to lay 1,000 bricks. What is the ratio of bags of mortar mix to bricks?
6. A roofer finds that it takes 27 bundles of shingles to cover 900 sq. ft. of roof. What is the ratio of bundles to sq. ft.?
7. When making punch you use 4 gallons of fruit juice to 2 gallons of water. What is the ratio you use when making punch?
8. If a welder uses 25 pounds of oxygen to 5 pounds of acetylene, what is the ratio of the gases?
9. A motor with a 3-inch pulley is driving a fan with a 12-inch pulley. What is the ratio of the motor to the fan?
10. A compressor has a suction pressure of 68.3 PSIG (83.0 PSIA) and a discharge pressure of 269.3 PSIG (285 PSIA). What is the compression ratio?

Given: $CR = \frac{\text{Discharge Pressure (PSIA)}}{\text{Suction Pressure (PSIA)}}$

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Write and solve proportions.

## PERFORMANCE OBJECTIVE #43

Given a verbal problem, write a proportion to solve the problem.

## SAMPLE ITEM

Write the proportion to solve this problem.
A nickel weighs 5 grams. A nickel is made by adding 3 grams of copper for every 1 gram of nickel. How much nickel is in a nickel?

(ans: $1/4 = X/5$)

## NOTES

Students sometimes find writing proportions easier if they first write the quantities involved as a ratio in words. For example, the ratio for the sample item above would be nickel to total weight.

After the students work on writing proportions, use these proportions for teaching solving. (Performance Objective #44)

## EVALUATION

Write proportions that could be used to solve these problems.

1. A cubic foot of water weighs 62.4 pounds and is about 7.5 gallons. How much does one gallon of water weigh?
2. A machine produces 280 pieces in 3.5 hours. How long does it take to produce 800 pieces?
3. An engine uses 6 gallons of gasoline to run 7 hours. If it runs at the same speed, how many gallons will it use in 16 hours?
4. A 320' roll of wire weighs 30 pounds. How many feet of the same wire are in a roll weighing 25 pounds?

## ANSWERS TO EVALUATION

1. $\frac{62.4}{7.5} = \frac{x}{1}$ or $\frac{62.4}{x} = \frac{7.5}{1}$

2. $\frac{280}{3.5} = \frac{800}{x}$ or $\frac{280}{800} = \frac{3.5}{x}$

3. $\frac{6}{7} = \frac{x}{16}$ or $\frac{6}{x} = \frac{7}{16}$

4. $\frac{320}{30} = \frac{x}{25}$ or $\frac{320}{x} = \frac{30}{25}$

## ANSWERS TO APPLICATIONS

1. $\frac{n}{17000} = \frac{8}{1000}$

2. $\frac{n}{800} = \frac{7}{1}$

3. $\frac{n}{925} = \frac{1}{100}$

4. $\frac{5}{1} = \frac{n}{8}$

5. $\frac{540}{x} = \frac{2}{1/3}$

6. $\frac{1.5}{1} = \frac{x}{10.5}$

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #43

Performance Objective #43: Given a verbal problem, write a proportion to solve the problem.

1. If it takes 8 bags of mortar mix to lay 1000 bricks, how many bags of mortar mix would one order to lay 17,000 bricks?
2. If 7 bricks cover one square foot of wall space, how many bricks would be needed to cover 300 square feet of wall space?
3. If one square of shingles covers 100 square feet, how many squares would one order to cover 925 square feet?
4. A coil cleaning liquid is mixed using a ratio of 5 parts of water to 1 part of cleaner. If 8 oz. of cleaner is used, how much water must be added?
5. If you have 540 yards of red fabric and each pattern uses 2 yards of red fabric and 1/3 yard of interfacing material, how much interfacing material would you need to make up all your red fabric?
6. A vertical fillet weld made with a weave bead requires 1 1/2 times as much rod as a flat fillet weld. A 24-inch long flat fillet weld requires 10 1/2 arc rods. How many rods will be required to make a vertical weld of the same length?

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Write and solve proportions.

## PERFORMANCE OBJECTIVE #44

Given a proportion with one unknown, solve the proportion.

## SAMPLE ITEM

Solve: $\frac{x}{7} = \frac{2}{3.5}$ (ans: $x = 4$)

## NOTES

When proportions have whole number or decimal components, a calculator is helpful for solving. When common fractions are used, however, answers should be given as common fractions.

Proportions are commonly used to determine cost or weight of material when dealing in smaller quantities than when the material was purchased.

## EVALUATION

Solve:

1. $\frac{1/8}{20} = \frac{x}{250}$
2. $\frac{7.2}{50} = \frac{30}{x}$
3. $\frac{3/8}{x} = \frac{1.5}{15.6}$
4. $\frac{6}{30} = \frac{0.1}{x}$

## ANSWERS TO EVALUATION

1. $\frac{25}{16}$ or $1\frac{9}{16}$ or 1.5625
2. 208.3
3. 3.9
4. 0.5

## ANSWERS TO APPLICATIONS

1. N = 2
2. N = 35
3. N = 108
4. 39 lbs.
5. $6.59
6. $2.49
7. 56.28 liters
8. 20 liters of solution

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #44

Performance Objective #44: Given a proportion with one unknown, solve the proportion.

Solve the following proportions:

1. $\frac{N}{8} = \frac{14}{56}$

2. $\frac{5}{7} = \frac{N}{49}$

3. $\frac{5}{9} = \frac{60}{N}$

4. If 125 ft. of copper tube weighs 13 lbs., how much do 375 feet weigh?

5. If 30 lbs. of R22 refrigerant cost $42.97, what do 4.6 lbs. cost?

6. If sheet metal costs $13.27 for a 4 ft. x 8 ft. piece, what will 3 ft. x 2 ft. piece cost?

7. An engine running at a constant speed uses 134 milliliters of gasoline per minute. How many liters of gasoline would this engine burn in 7 hours?

8. A solution contains 20% acid and 80% water. How many liters of solution can be made with 4 liters of acid?

## COMPETENCY

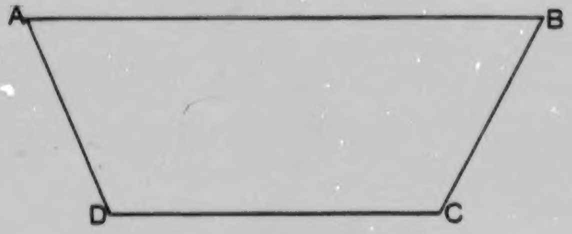
Interpret and use scale drawings.

## PERFORMANCE OBJECTIVE #45

Given a scale drawing, write and solve a proportion to find unknown lengths.

## SAMPLE ITEM

On this drawing of a lot, 1 cm = 15 m.
How long is side AB in meters?
(ans. 114 m)



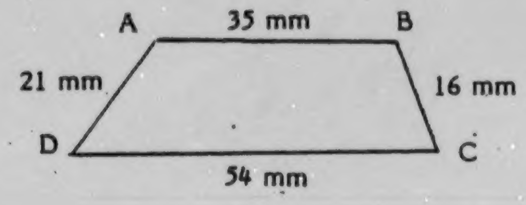
## NOTES

Give the students maps or actual scale drawings and have them measure the lengths on the drawings and then compute the actual length. Another activity is to have the students do scale drawings of their classroom or some part of the school.

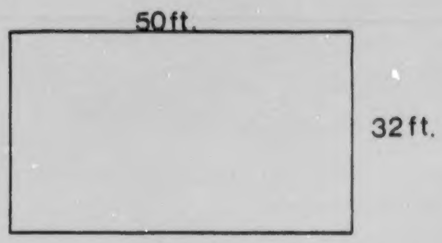
House plans are usually drawn to a scale of 1/4" = 1'0". This scale allows the construction worker to interpret information from a sheet much smaller than the structure he/she is building. It would be very impractical, if not impossible, to draw a building plan the actual size of the building.

## EVALUATION

1. Find:
   a) AB
   b) DC
   Scale 1 cm = 12 m



2. This building must be drawn to a scale of 1 ft = 1/8 in.
   a) What length on the scale drawing will represent the length?
   b) What length on the scale drawing will represent the width?



## ANSWERS TO EVALUATION

1. a) 42 m
   b) 64.8 m

2. a) 6 1/4 in.
   b) 4 in.

## ANSWERS TO APPLICATIONS

1. 6.8 cm

2. 21.3 cm

3. 19 3/4"

4. A = 64'
   B = 24'
   C = 56'

5. A = 7'0"
   B = 14'0"
   C = 6'0"
   D = 8'0"

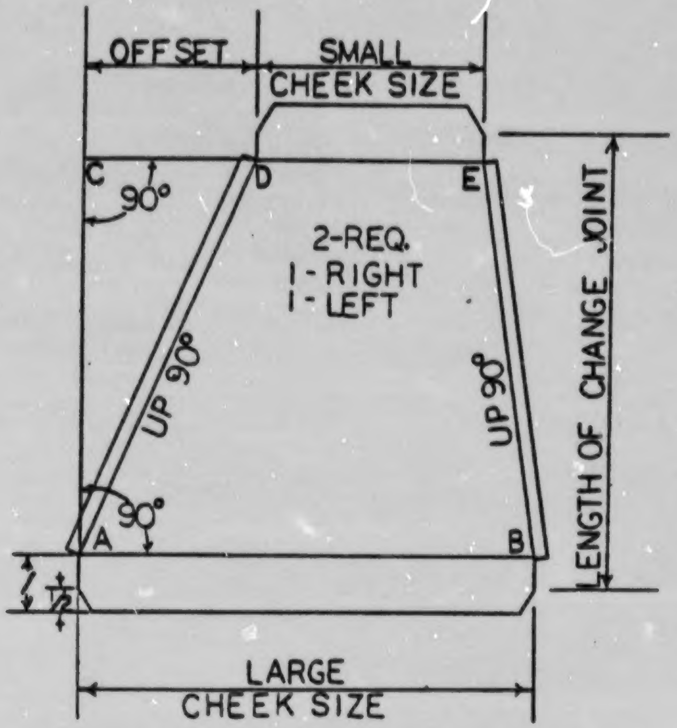
6. A = 11 ft.
   B = 11 1/2 ft.
   C = 12 ft.
   D = 8 1/2 ft.
   E = 16 ft.

### APPLICATIONS
### FOR
### PERFORMANCE OBJECTIVE #45

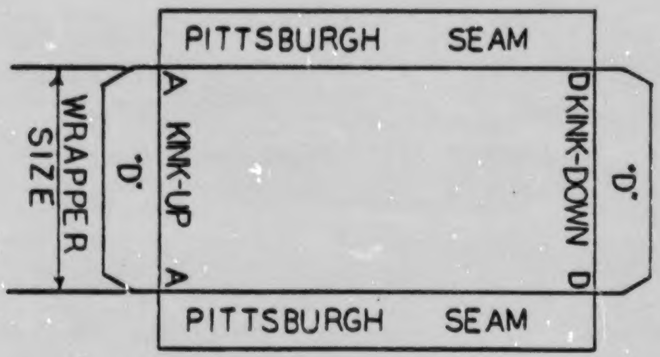
Performance Objective #45: Given a scale drawing, write and solve a proportion to find unknown lengths.

1. If dimension AB is 6.8 cm and DE is 3.3 cm, what will be the dimension of DE if AB is 14 cm?

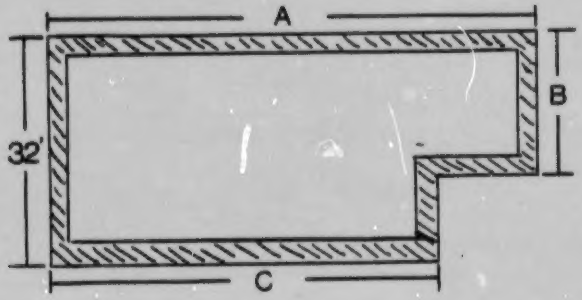
2. If dimension AB is 6.8 cm and BE is 5.8 cm, what will be the dimension of AB if BE is 18.2 cm?


OFFSET
SMALL
CHEEK SIZE
C
D
E
90°
2-REQ.
1-RIGHT
1-LEFT
UP 90°
UP 90°
90°
A
B
LENGTH OF CHANGE JOINT
1/2
LARGE
CHEEK SIZE

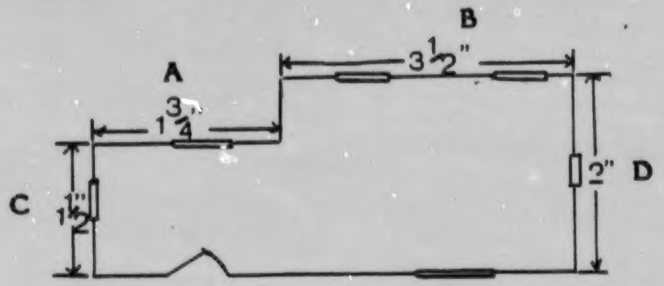
3. Dimension AD is two times longer than AA. What will be the dimension of AA if AD is 39 1/2" long?


PITTSBURGH SEAM
WRAPPER SIZE
"D"
A
KINK-UP
A
D
KINK-DOWN
D
"D"
PITTSBURGH SEAM

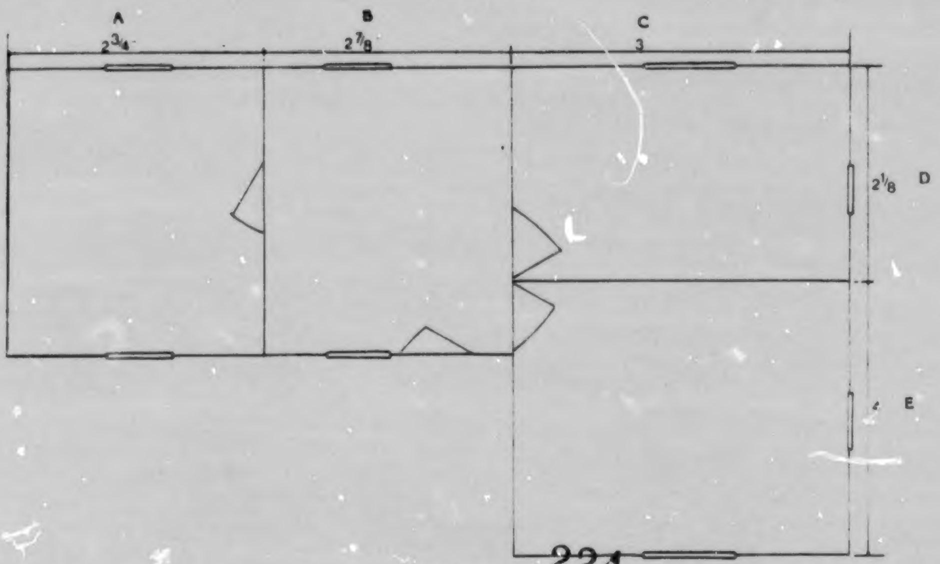
4. Using a ruler and proportions, find the dimensions A, B and C.
Scale: 1/8"= 2'



5. Determine the length of sides A, B, C and D. The actual measurements are shown on the drawing.
Scale: 1/4" = 1'0"



6. Below is a scale drawing of a floor plan of a house. The scale is 1/4" = 1'0". The measurements on the drawing are actual measurements. What lengths do these measurements represent?



# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Write equivalent forms of percents, decimals and common fractions.

## PERFORMANCE OBJECTIVE #46

Given a percent, write the equivalent common fraction and decimal.

## SAMPLE ITEM

Write as a common fraction and decimal: 80%

(ans: 80/100 = 4/5 and 0.80 or 0.8)

## NOTES

Performance Objectives #46 - 48 should be taught together and not in isolation. Stressing that percent is a ratio whose second component is 100 makes all the conversions easier. Have the students write this ratio first and then write the decimal equivalent.

## REFERENCE TO TEXT

**Applied General Mathematics** (AGM), pages 207-212

## EVALUATION

Write each percent as a common fraction and a decimal fraction.

1. 4 1/2%
2. 130%
3. 86%
4. 7%

## ANSWERS TO EVALUATION

1. $\frac{4\ 1/2}{100} = \frac{9}{200}$

   0.04 1/2 or 0.045

2. $\frac{130}{100} = \frac{13}{10}$

   1.3

3. $\frac{86}{100} = \frac{43}{50}$

   0.86

4. $\frac{7}{100}$

   0.07

## ANSWERS TO APPLICATIONS

1. a) 0.20, $\frac{1}{5}$

   b) 0.375, $\frac{3}{8}$

   c) 0.0325, $\frac{13}{400}$

2. 0.20, $\frac{1}{5}$

3. $\frac{7}{20}$, 0.35

4. $1\frac{21}{50}$ or $\frac{71}{50}$, 1.42

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# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #46

Performance Objective #46: Given a percent, write an equivalent decimal and common fraction.

1. Write the equivalent decimal and common fraction for the following percents.

   a) 20%

   b) $37\frac{1}{2}\%$

   c) $3\frac{1}{4}\%$

2. In determining the amount of lumber needed for a construction project, 20% is allowed for waste in cutting. What decimal and common fraction represent this amount?

3. On a certain job the materials will account for 35% of the total cost. Write this percent as a common fraction and a decimal fraction.

4. Last quarter's production at Smith's Plant was 142% of the previous quarter. Write this percent as a common fraction and a decimal fraction.

## COMPETENCY

Write equivalent forms of percents, decimals and common fractions.

## PERFORMANCE OBJECTIVE #47

Given a decimal, write the equivalent common fraction and percent.

## SAMPLE ITEM

Write as a common fraction and percent: 0.16

(ans: $\frac{16}{100} = \frac{4}{25}$ and $\frac{16}{100} = 16\%$)

## NOTES

Students frequently have problems with moving decimals left and right when working with decimals and percents. Help the students rely on what they already know (how to read decimals) and the fact that percent is a ratio whose second component is 100. When writing equivalent forms, write the decimal first as a common fraction by writing it as it is read.

## REFERENCE TO TEXT

**Applied General Mathematics** (AGM), pages 207-212

## EVALUATION

Write each of the following decimals as common fractions and percents.

1. 0.85
2. 0.06
3. 0.155
4. 3.5

## ANSWERS TO EVALUATION

1. $\frac{85}{100} = \frac{17}{20}$

   $\frac{85}{100} = 85\%$

2. $\frac{6}{100} = \frac{3}{50}$

   $\frac{6}{100} = 6\%$

3. $\frac{155}{1000} = \frac{31}{200}$

   $\frac{155}{1000} = \frac{15.5}{100} = 15.5\%$

4. $\frac{3.5}{1} = \frac{7}{2}$

   $\frac{3.5}{1} = \frac{350}{100} = 350\%$

## ANSWERS TO APPLICATIONS

1. a) $37\frac{1}{2}\%$, $\frac{3}{8}$

   b) $33\frac{1}{3}\%$, $\frac{1}{3}$

   c) $6\frac{1}{3}\%$, $\frac{63}{1000}$

2. $\frac{3}{50}$, $6\%$

3. $\frac{1}{6}$, $16\frac{2}{3}\%$

4. $\frac{289}{1000}$, $28.9\%$

5. $10\%$, $\frac{1}{10}$

6. $18\%$, $\frac{9}{50}$

7. $71\%$, $\frac{5}{7}$

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #47

Performance Objective #47: Given a decimal, write the equivalent of a common fraction and percent.

1. Express each decimal as a percent and a common fraction.

   a) 0.375

   b) 0.333

   c) 0.063

2. The slope of a road was given as 0.06. Write this slope as a common fraction and percent.

3. A gear ratio was given as $0.16\frac{2}{3}$. Write this ratio as a common fraction and a percent.

4. A batter has a batting average of 0.289. Write this average as a common fraction and a percent.

5. On a residence, .10 of the total cost is for carpentry labor. What percent and what common fractional part of the total is for carpentry?

6. In milling lumber, .18 is allowed for waste. Express this as a percent and as a common fraction.

7. A formula for a cleaning solution requires 40 parts per 100 parts water. What percent of the solution is water? What fractional part is water?

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Write equivalent forms of percents, decimals and common fractions.

## PERFORMANCE OBJECTIVE #48

Given a common fraction, write the equivalent percent and decimal fraction.

## SAMPLE ITEM

Write as a percent and a decimal: 3/4

(ans: $\frac{3}{4} = \frac{x}{100} = \frac{75}{100} =$ 75% or 0.75)

## NOTES

Since percent is a ratio whose second component is 100, common fractions may be changed to percents by writing a proportion and solving.

## REFERENCE TO TEXT

**Applied General Mathematics** (AGM), pages 207-212

## EVALUATION

Write as percents and decimals.

1. 3/8
2. 1/5
3. 1/3
4. 5/4

## ANSWERS TO EVALUATION

1. $\frac{3}{8} = \frac{x}{100} = \frac{37.5}{100} = 37.5\%$

   $\frac{37.5}{100} = \frac{375}{1000} = 0.375$

2. $\frac{1}{5} = \frac{x}{100} = \frac{20}{100} = 20\%$

   $\frac{20}{100} = 0.20$

3. $\frac{1}{3} = \frac{x}{100} = \frac{33\ 1/3}{100} = 33\frac{1}{3}\%$

   $\frac{33\ 1/3}{100} = 0.33\frac{1}{3}$

4. $\frac{5}{4} = \frac{x}{100} = \frac{125}{100} = 125\%$

   $\frac{125}{100} = 1.25$

## ANSWERS TO APPLICATIONS

1. a) 90%, 0.9

   b) $87\frac{1}{2}\%$, 0.875

   c) $6\frac{1}{4}\%$, 0.0625

2. 95%, 0.95

3. $72\frac{8}{11}\%$, 0.72

4. $12\frac{1}{2}\%$, 0.125

5. 0.167, 16.7%

6. 0.1, 10%

7. .2, 20%

8. a) 0.05, 5%
   b) 0.067, 6.7%
   c) 0.083, 8.3%
   d) .053, 5.3%

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #48

Performance Objective #48: Given a common fraction, write the equivalent percent and decimal fraction.

1. Express each common fraction as a percent and decimal fraction.

   a) 9/10

   b) 7/8

   c) 1/16

2. On a given day 19/20 of the employees were present. Write this common fraction as a percent and a decimal.

3. The center made 8 of 11 free throws attempted. Write this ratio as a percent and a decimal.

4. Many architects charge a fee of 1/8 the total cost of a building for their services of planning, supervising and consultations. Write this common fraction as a percent and a decimal.

5. In addition to labor and materials cost, a contractor added 1/6 the cost of labor and materials for overhead and profit. What is the decimal equivalent and percent that 1/6 represents? (Round off answer to three decimal places.)

6. The town of Bostick approved 1/10 of the budget for essential services such as garbage collection, street cleaning, water and sewer, maintenance, etc. Express this amount as a decimal and as a percent.

7. In determining the amount of lumber needed for sheathing a roof, the contractor added 1/5 to the roof area. Express 1/5 as a decimal and as a percent.

8. The general contractor's bid shows the following costs plus profits added by the subcontractor. Express as decimals and percents.

| Subcontractor | Cost | Profit Added |
|---|---|---|
| Plumbing | $6,250 | 1/20 |
| Masonry | $8,490 | 1/15 |
| Electrical | $3,056 | 1/12 |
| Heating | $2,175 | 1/19 |

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# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Solve percent problems.

## PERFORMANCE OBJECTIVE #49

Given a percent problem, find the missing rate, base or part.

## SAMPLE ITEM

A job cost $4200. Of this amount 36% was materials. How much did the materials cost? (ans: 36% of $4200 = $512)

## NOTES

Many students have trouble translating the words in a percent problem to a "formula." To help with this, have the students read the problem and write the information in the form: ______% of ______ = ______. Once this translation is made, writing a proportion or algebraic equation is simple.

## REFERENCE TO TEXT

**Applied General Mathematics** (AGM), pages 212-221

## EVALUATION

Solve these problems.

1. A welder making $8.15 an hour receives a 4% raise. What is the new hourly rate?
2. A 4-foot piece of metal expands 0.375 inches. What percent did it expand?
3. A piece of machinery is insured for $40,000, which is 80% of its replacement cost. What is the replacement cost?
4. In making plate glass, 72% of the ingredients is sand. How much sand is needed to make 125 kilograms of sand?

## ANSWERS TO EVALUATION

1. $8.48 per hour
2. 0.8%
3. $50,000
4. 90 kg

## ANSWERS TO APPLICATIONS

1. $35,556.40
2. 73.5%
3. $9.00
4. 58.9 oz.
5. 2.61 HP
6. 32%
7. 225 hrs.
8. $70.38
9. $450.00
10. 0.25%
11. 5%
12. a) $4.77
    b) $5.06
13. 262 sq. ft.
14. $4,091.22
15. $2,056.56
16. 5,265 sq. ft.
17. 21%
18. 8.0%
19. $4.75 saved and $232.81 paid

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #49

Performance Objective #49: Given a percent problem, find the missing rate, base or part.

1. In preparing a bid a contractor finds that the matetrials will cost $32,324. However, the contractor needs to allow 10% for inflation. How much should be figured for materials in preparing the bid?

2. The materials for a house cost $35,000. The labor cost $12,600. What percent of the total did the materials cost?

3. The brick masons want a 20% increase in salary. Their current hourly wage is $7.50. What would be the new hourly wage?

4. Solder is composed of 95% tin and 5% antimony. What is the weight of tin if a roll of solder weighs 62 oz.?

5. An electric motor is listed as 3 HP but is only 87% efficient. What horsepower does it deliver?

6. A compressor costs $189.20 and the dealer will sell the compressor to a service person for $128.80. What is the rate of discount?

7. A local manufacturing manager stated that they had a job requiring 1,800 hours to complete and that 12 1/2% of the time was to be spent on a grinding operation. This operation amounted to how many hours?

8. A tool and supply company offered a 12% discount on orders of $100 or more. What would the discount be for an order of $586.40?

9. A machinist sold a box of tools for $292.50. If this was 65% of the original cost, what was the original cost?

10. In a machine manufacturing plant, 24 of the last 9,600 hours were lost due to accidents. What percentage of time was lost?

11. A local manufacturer produced 2,460 machine parts. Of these, 123 were defective. What was the percentage of defective parts?

12. A machine shop student was hired by a local manufacturer at the rate of $4.50 per hour. At the end of 30 days the student was given a 6% raise. At the end of 90 days the student was given another 6% raise.

    a) What was the student's hourly rate at beginning of the 2nd month?
    b) What was the student's hourly rate at the start of the 91st day?

13. Many contractors allow 10% for waste when determining the amount of sheathing needed for a roof of tongue and groove boards. If the roof area is 2,620 sq. ft., how many square feet must be added for waste?

14. The carpentry subcontractor is allowed 21% of the total labor cost of a residence construction. The total labor cost is $19,482. How much is allowed for carpentry?

15. The Smith family was told by a local painter that he/she usually paints house exteriors for the cost of materials plus a fee of 14% of the cost. How much should the Smith family expect to pay for painting their house if the cost of materials is $1,804?

16. An ordinance in the town of Hinesville states that a residence must not cover more than 45% of the lot upon which it is constructed. What is the maximum size house (sq. ft.) that can be constructed on a lot 150 ft. long by 78 ft. wide?

17. A bricklayer charges a homeowner $1,046 for a job. This amount includes a profit of $219.66. What is the bricklayer's rate of profit?

18. The excavation charges for an $27,500 house come to $2,187.00. What percent of the total cost (to nearest 1/2 percent) is this amount?

19. If there is a 2% discount for payment within 10 days of receipt of invoice and the invoice amount is $237.56, how much money could you save if you paid by day 5? How much money should you pay?

# graphs and tables

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

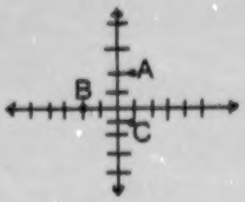
Locate points in a coordinate plane.

## PERFORMANCE OBJECTIVE #50

Given a list of ordered pairs and a set of points in a coordinate plane, match one set of ordered pairs to the points.

## SAMPLE ITEM

| | |
|---|---|
| 1. (-2,0) | 1. B |
| 2. (1,-1) | 2. C |



## NOTES

The concepts of ordered pairs and locating points in a plane are important even though their application is not always direct in vocational areas. Put the most emphasis on points in the first quadrant. You may wish to use maps to demonstrate locating points using a grid system.

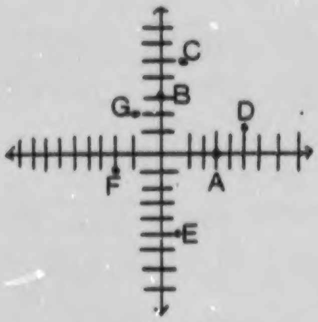
## REFERENCE TO TEXT

**Applied General Mathematics** (AGM), pages 240-241

## EVALUATION

Find the point on the graph that corresponds to each ordered pair.

1. (-1, 2)
2. (0, 3)
3. (1, -5)
4. (5, 1)



## ANSWERS TO EVALUATION

1. G
2. B
3. E
4. D

## ANSWERS TO APPLICATIONS

1. a) B
   b) F
   c) A
   d) C
   e) D
2. a) (-20, 2)
   b) (15, 4)
   c) (30, 2)
   d) (40, 6)
   e) (55, 3)
   f) (60, -3)
   g) (40, -5)
   h) (20, 0)
   i) (0, -3,5)

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #50

Performance Objective #50: Given a list of ordered pairs and a set of points in a coordinate plane, match one ordered pairs to the points.

1. Name the point paired with each ordered pair.

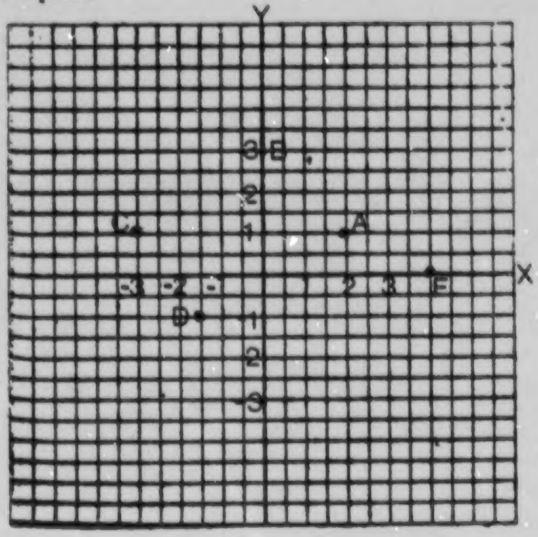
   a. (0,3)

   b. (4,0)

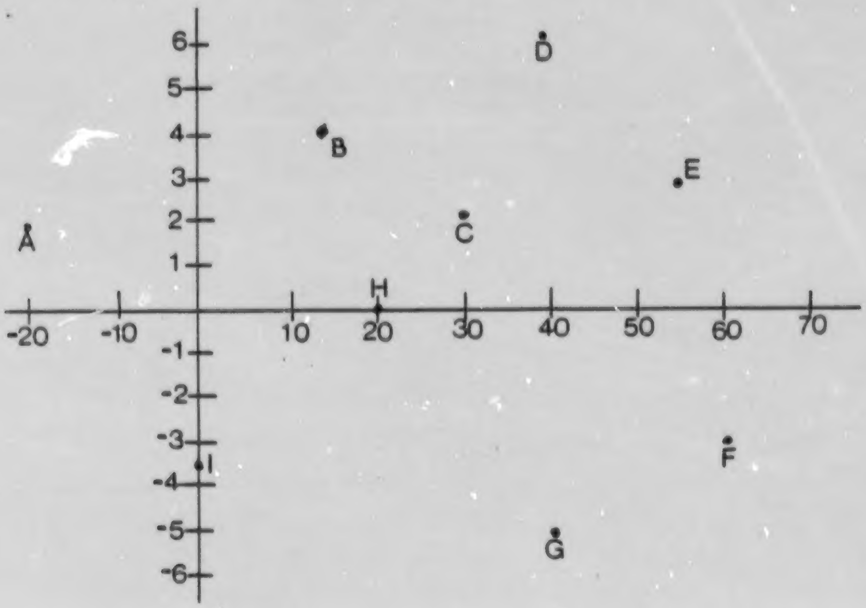
   c. (2,1)

   d. (-3,1)

   e. (-1.5,-1)


Y
X
3
E
2
1
C
A
-3
-2
-1
2
3
B
D
-1
-2
-3

2. Identify points A-I as ordered pairs (x,y).


6
5
4
3
2
1
-1
-2
-3
-4
-5
-6
-20
-10
10
20
30
40
50
60
70
A
B
C
D
E
F
G
H
I

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Read information from a table.

## PERFORMANCE OBJECTIVE #51

Given a table, answer questions pertaining to the information in the table.

## NOTES

Collect and use tables that are actually used in the trades and industries areas. Reading mathematical tables is also an important skill. Tables are used because much vital information can be recorded in a small space and in a format that is easy to access.

## EVALUATION

| | Amarillo, Texas | Atlanta, Georgia | Baltimore, Maryland | Birmingham, Alabama | Bismarck, North Dakota |
|---|---|---|---|---|---|
| Albuquerque, New Mexico | 284 | 1381 | 1829 | 1251 | 1088 |
| Amarillo, Texas | 0 | 1097 | 1554 | 967 | 948 |
| Atlanta, Georgia | 1097 | 0 | 645 | 150 | 1495 |
| Austin, Texas | 483 | 919 | 1519 | 769 | 1324 |
| Baltimore, Maryland | 1554 | 645 | 0 | 773 | 1499 |

1. How far is it from Atlanta, Georgia to Amarillo, Texas?
2. Which two cities are 773 miles apart?
3. Which city is nearest to Birmingham, Alabama?
4. How far is it from Austin, Texas to Baltimore, Maryland if the person drives through Atlanta, Georgia?

## ANSWERS TO EVALUATION

1. 1,097 miles
2. Birmingham and Baltimore
3. Atlanta
4. 1,564 miles

## ANSWERS TO APPLICATIONS

1. a) 13.6 HTM
   b) 2.3 HTM
   c) 3.3 HTM

2. a) 9.2 PSIG
   b) 259.9 PSIG
   c) 12°F
   d) -70°F

3. a) 0.042"
   b) 1.025"
   c) 0.1982 lbs.
   d) 0.5197 sq. ft.

4. a) .6777
   b) 0.4488
   c) 0.3611

5. a) 14%
   b) 20%
   c) 24%
   d) 9%
   e) 10 $\frac{1}{2}$"
   f) 32%

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #51

Performance Objective #51: Given a table, answer questions pertaining to the information in the table.

Wood Frame and Masonry Walls and Partitions. Factors include heat loss due to transmission only.

| Winter Temperature Difference | | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 | UT | UE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **No. 12** Wood Frame Exterior Walls With Sheathing and Siding or Brick Veneer, or Other Exterior Finish. | | | | | | | | | | | | | | | | | | |
| Cavity Insul | Sheathing | (Btuh per sq. ft.) | | | | | | | | | | | | | | | | |
| A. None | ½" Gypsum Brd (R-0.5) | 8.1 | 9.5 | 10.8 | 12.2 | 13.6 | 14.9 | 16.3 | 17.6 | 19.0 | 20.3 | 21.7 | 23.0 | 24.4 | 25.7 | 27.1 | 0.271 | |
| B. None | ½" Asphalt Brd (R-1.3) | 6.5 | 7.6 | 8.7 | 9.8 | 10.8 | 11.9 | 13.0 | 14.1 | 15.2 | 16.3 | 17.4 | 18.4 | 19.5 | 20.6 | 21.7 | 0.217 | |
| C. R-11 | ½" Gypsum (R-0.5) | 2.7 | 3.1 | 3.6 | 4.0 | 4.5 | 4.9 | 5.4 | 5.8 | 6.3 | 6.7 | 7.2 | 7.6 | 8.1 | 8.5 | 9.0 | 0.090 | |
| D. R-11<br>R-11<br>R-13 | ½" Asphalt Brd (R-1.3)<br>½" Bead Brd (R-1.8)<br>½" Gypsum Brd (R-0.5) | 2.4 | 2.8 | 3.2 | 3.6 | 4.0 | 4.4 | 4.8 | 5.2 | 5.6 | 6.0 | 6.4 | 6.8 | 7.2 | 7.6 | 8.0 | 0.080 | |
| E. R-11<br>R-11<br>R-13<br>R-13 | ½" Extr Poly Brd (R-2.5)<br>⅝" Bead Brd (R-2.7)<br>½" Asphalt Brd (R-1.3)<br>⅜" Bead Brd (R-1.8) | 2.3 | 2.6 | 3.0 | 3.4 | 3.8 | 4.1 | 4.5 | 4.9 | 5.3 | 5.6 | 6.0 | 6.4 | 6.8 | 7.1 | 7.5 | 0.075 | |
| F. R-11<br>R-11<br>R-13<br>R-13 | 1" Bead Brd (R-3.6)<br>¾" Extr Poly Brd (R-3.8)<br>½" Extr Poly Brd (R-2.5)<br>¾" Bead Brd (R-2.7) | 2.1 | 2.4 | 2.8 | 3.2 | 3.5 | 3.8 | 4.2 | 4.6 | 4.9 | 5.3 | 5.6 | 5.9 | 6.3 | 6.6 | 7.0 | 0.070 | |
| G. R-13<br>R-13 | ¾" Extr Poly Brd (R-3.8)<br>1" Bead Brd (R-3.6) | 2.0 | 2.3 | 2.6 | 2.9 | 3.3 | 3.6 | 3.9 | 4.2 | 4.6 | 4.9 | 5.2 | 5.5 | 5.0 | 6.2 | 6.5 | 0.065 | |
| H. R-11<br>R-13<br>R-19 | 1" Extr Poly Brd (R-5.0)<br>1" Extr Poly Brd (R-5.0)<br>½" Gypsum Brd (R-0.5) | 1.8 | 2.1 | 2.4 | 2.7 | 3.0 | 3.3 | 3.6 | 3.9 | 4.2 | 4.5 | 4.8 | 5.1 | 5.4 | 5.7 | 6.0 | 0.060 | |
| I. R-19<br>R-19 | ½" Asphalt Brd (R-1.3)<br>½" Bead Brd (R-1.8) | 1.6 | 1.9 | 2.2 | 2.5 | 2.8 | 3.0 | 3.3 | 3.6 | 3.8 | 4.1 | 4.4 | 4.7 | 4.9 | 5.2 | 5.5 | 0.055 | |
| J. R-11<br>R-13<br>R-19<br>R-19 | R-8 Sheathing<br>R-8 Sheathing<br>½" or ¾" Extr Poly Brd<br>¾" or 1" Bead Brd | 1.5 | 1.7 | 2.0 | 2.2 | 2.5 | 2.7 | 3.0 | 3.2 | 3.5 | 3.7 | 4.0 | 4.2 | 4.5 | 4.7 | 5.0 | 0.050 | |
| K. R-19 | 1" Extr Poly Brd (R-5.0) | 1.3 | 1.6 | 1.8 | 2.0 | 2.2 | 2.5 | 2.7 | 2.9 | 3.1 | 3.4 | 3.6 | 3.8 | 4.0 | 4.3 | 4.5 | 0.045 | |
| L. R-19 | R-8 Sheathing | 1.2 | 1.4 | 1.6 | 1.8 | 2.0 | 2.2 | 2.4 | 2.6 | 2.8 | 3.0 | 3.2 | 3.4 | 3.6 | 3.8 | 4.0 | 0.040 | |

1. What is the Heat Multiplier Factor (HTM) for the following wood frame exterior walls with:

   a) No cavity insulation and gypsum board at 50°F temperature difference.

   b) Cavity insulation of R-13 and 3/4" extruded polystyrene board at 35°F temperature difference.

   c) Cavity insulation of R-19 and 1/2" asphalt board at 60°F temperature difference.

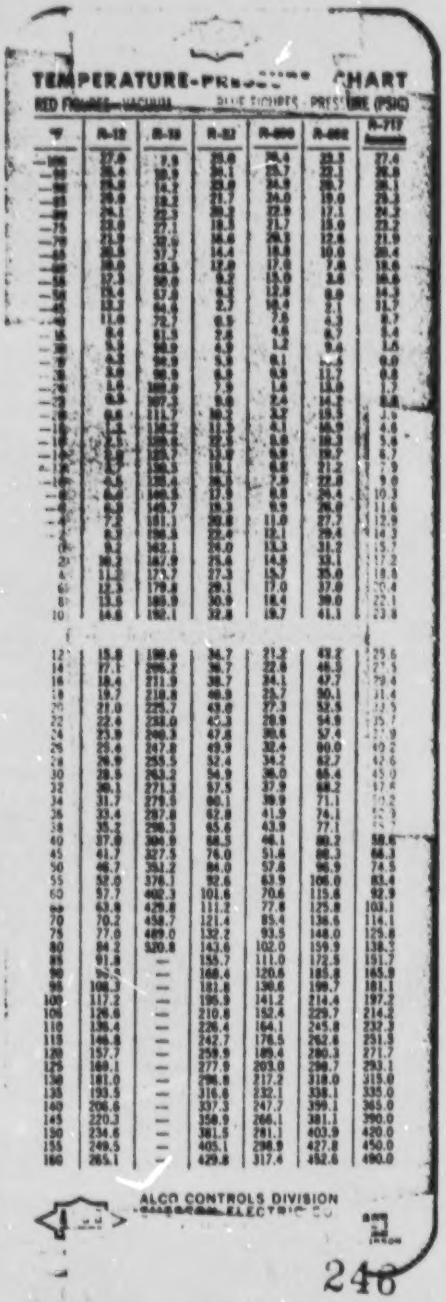
2. Using the pressure-temperature chart find the following:

    a) Pressure of R12 @ 0°F.

    b) Pressure of R22 @ 120°F.

    c) Temperature of R500 @ 21.2 PSIG.

    d) Temperature of R502 @ 12.6 inches of Mercury Vacuum.



ALCO CONTROLS DIVISION

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## Table 6-26

## Dimensions of Type "L" Copper Tubing

| TYPE | DIAMETERS | | WALL THICKNESS INCHES | WEIGHT PER FOOT LBS. | TRANSVERSE AREA OF BORE | | SURFACE AREA PER FOOT OF LENGTH | |
|---|---|---|---|---|---|---|---|---|
| | OUTSIDE INCHES | INSIDE INCHES | | | SQ. IN. | SQ. FT. | EXTERNAL SQ. FT. | INTERNAL SQ. FT |
| L | 1/2 | 0.430 | 0.035 | 0.1982 | 0.1452 | 0.001008 | 0.1309 | 0.1126 |
| | 5/8 | 0.545 | 0.040 | 0.2849 | 0.2333 | 0.001620 | 0.1636 | 0.1427 |
| | 3/4 | 0.666 | 0.042 | 0.3621 | 0.3484 | 0.002419 | 0.1963 | 0.1744 |
| | 7/8 | 0.785 | 0.045 | 0.4548 | 0.4840 | 0.003361 | 0.2291 | 0.2055 |
| | 1-1/8 | 1.025 | 0.050 | 0.6545 | 0.8252 | 0.005730 | 0.2945 | 0.2863 |
| | 1-3/8 | 1.265 | 0.055 | 0.8840 | 1.257 | 0.008728 | 0.3600 | 0.3312 |
| | 1-5/8 | 1.505 | 0.060 | 1.143 | 1.779 | 0.01235 | 0.4254 | 0.3940 |
| | 2-1/8 | 1.985 | 0.070 | 1.752 | 3.095 | 0.02149 | 0.5563 | 0.5197 |
| | 2-5/8 | 2.465 | 0.080 | 2.479 | 4.772 | 0.03314 | 0.6872 | 0.6453 |
| | 3-1/8 | 2.945 | 0.090 | 3.326 | 6.812 | 0.04730 | 0.8181 | 0.7710 |
| | 3-5/8 | 3.425 | 0.100 | 4.292 | 9.213 | 0.06398 | 0.9490 | 0.8967 |
| | 4-1/8 | 3.905 | 0.110 | 5.38 | 12.0 | 0.0833 | 1.08 | 1.02 |
| | 5-1/8 | 4.875 | 0.125 | 7.61 | 18.7 | 0.1300 | 1.34 | 1.28 |
| | 6-1/8 | 5.845 | 0.140 | 10.20 | 26.8 | 0.1862 | 1.60 | 1.53 |

3. For Type "L" copper tubing find the following:

   a) Wall thickness of 3/4" OD.

   b) Inside diameter of 1 1/8" OD.

   c) Weight per foot of 1/2" OD.

   d) Internal surface area per foot of length of 2 1/8" OD.

4. Using trigonometric functions tables (such as the one attached) complete the following:

   a) sin 42° 40'

   b) cos 63° 20'

   c) sin 21° 10'

# NATURAL FUNCTIONS

## MINUTES TO DEGREES (Hundredths)

(May be rounded off to tenths)

| Minutes | Degrees | Minutes | Degrees |
|---|---|---|---|
| 1 | .02 | 16 | .27 |
| 2 | .03 | 17 | .28 |
| 3 | .05 | 18 | .30 |
| 4 | .07 | 19 | .32 |
| 5 | .08 | 20 | .33 |
| 6 | .10 | 21 | .35 |
| 7 | .12 | 22 | .36 |
| 8 | .13 | 23 | .38 |
| 9 | .15 | 24 | .40 |
| 10 | .17 | 25 | .42 |
| 11 | .18 | 26 | .43 |
| 12 | .20 | 27 | .45 |
| 13 | .21 | 28 | .46 |
| 14 | .23 | 29 | .48 |
| 15 | .25 | 30 | .50 |
| Minutes | Degrees | Minutes | Degrees |

51-6

| TAN | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | |
|---|---|---|---|---|---|---|---|---|
| 0 | .0000 | .0029 | .0058 | .0087 | .0116 | .0145 | .0175 | 89 |
| 1 | .0175 | .0204 | .0233 | .0262 | .0291 | .0320 | .0349 | 88 |
| 2 | .0349 | .0378 | .0407 | .0437 | .0466 | .0495 | .0524 | 87 |
| 3 | .0524 | .0553 | .0582 | .0612 | .0641 | .0670 | .0699 | 86 |
| 4 | .0699 | .0729 | .0758 | .0787 | .0816 | .0846 | .0875 | 85 |
| 5 | .0875 | .0904 | .0934 | .0963 | .0992 | .1022 | .1051 | 84 |
| | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | |
| 6 | .1051 | .1080 | .1110 | .1139 | .1169 | .1198 | .1228 | 83 |
| 7 | .1228 | .1257 | .1287 | .1317 | .1346 | .1376 | .1405 | 82 |
| 8 | .1405 | .1435 | .1465 | .1495 | .1524 | .1554 | .1584 | 81 |
| 9 | .1584 | .1614 | .1644 | .1673 | .1703 | .1733 | .1763 | 80 |
| 10 | .1763 | .1793 | .1823 | .1853 | .1883 | .1914 | .1944 | 79 |
| | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | |
| 11 | .1944 | .1974 | .2004 | .2035 | .2065 | .2095 | .2126 | 78 |
| 12 | .2126 | .2156 | .2186 | .2217 | .2247 | .2278 | .2309 | 77 |
| 13 | .2309 | .2339 | .2370 | .2401 | .2432 | .2462 | .2493 | 76 |
| 14 | .2493 | .2524 | .2555 | .2586 | .2617 | .2648 | .2679 | 75 |
| 15 | .2679 | .2711 | .2742 | .2773 | .2805 | .2836 | .2867 | 74 |
| | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | |
| 16 | .2867 | .2899 | .2931 | .2962 | .2994 | .3026 | .3057 | 73 |
| 17 | .3057 | .3089 | .3121 | .3153 | .3185 | .3217 | .3249 | 72 |
| 18 | .3249 | .3281 | .3314 | .3346 | .3378 | .3411 | .3443 | 71 |
| 19 | .3443 | .3476 | .3508 | .3541 | .3574 | .3607 | .3640 | 70 |
| 20 | .3640 | .3673 | .3706 | .3739 | .3772 | .3805 | .3839 | 69 |
| | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | |
| 21 | .3839 | .3872 | .3906 | .3939 | .3973 | .4006 | .4040 | 68 |
| 22 | .4040 | .4074 | .4108 | .4142 | .4176 | .4210 | .4245 | 67 |
| 23 | .4245 | .4279 | .4314 | .4348 | .4383 | .4417 | .4452 | 66 |
| 24 | .4452 | .4487 | .4522 | .4557 | .4592 | .4628 | .4663 | 65 |
| 25 | .4663 | .4699 | .4734 | .4770 | .4806 | .4841 | .4877 | 64 |
| | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | |
| 26 | .4877 | .4913 | .4950 | .4986 | .5022 | .5059 | .5095 | 63 |
| 27 | .5095 | .5132 | .5169 | .5206 | .5243 | .5280 | .5317 | 62 |
| 28 | .5317 | .5354 | .5392 | .5430 | .5467 | .5505 | .5543 | 61 |
| 29 | .5543 | .5581 | .5619 | .5658 | .5696 | .5735 | .5774 | 60 |
| 30 | .5774 | .5812 | .5851 | .5890 | .5930 | .5969 | .6009 | 59 |
| | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | |
| 31 | .6009 | .6048 | .6088 | .6128 | .6168 | .6208 | .6249 | 58 |
| 32 | .6249 | .6289 | .6330 | .6371 | .6412 | .6453 | .6494 | 57 |
| 33 | .6494 | .6536 | .6577 | .6619 | .6661 | .6703 | .6745 | 56 |
| 34 | .6745 | .6787 | .6830 | .6873 | .6916 | .6959 | .7002 | 55 |
| 35 | .7002 | .7046 | .7089 | .7133 | .7177 | .7221 | .7265 | 54 |
| | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | |
| 36 | .7265 | .7310 | .7355 | .7400 | .7445 | .7490 | .7536 | 53 |
| 37 | .7536 | .7581 | .7627 | .7673 | .7720 | .7766 | .7813 | 52 |
| 38 | .7813 | .7860 | .7907 | .7954 | .8002 | .8050 | .8098 | 51 |
| 39 | .8098 | .8146 | .8195 | .8243 | .8292 | .8342 | .8391 | 50 |
| 40 | .8391 | .8441 | .8491 | .8541 | .8591 | .8642 | .8693 | 49 |
| | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | |
| 41 | .8693 | .8744 | .8796 | .8847 | .8899 | .8952 | .9004 | 48 |
| 42 | .9004 | .9057 | .9110 | .9163 | .9217 | .9271 | .9325 | 47 |
| 43 | .9325 | .9380 | .9435 | .9490 | .9545 | .9601 | .9657 | 46 |
| 44 | .9657 | .9713 | .9770 | .9827 | .9884 | .9942 | 1.000 | 45 |
| 45 | 1.000 | 1.006 | 1.012 | 1.018 | 1.024 | 1.030 | | 44 |
| | 60′ | 50′ | 40′ | 30′ | 20′ | 10′ | 0′ | COT |

| TAN | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | |
|---|---|---|---|---|---|---|---|---|
| 46 | 1.036 | 1.042 | 1.048 | 1.054 | 1.060 | 1.066 | 1.072 | 43 |
| 47 | 1.072 | 1.079 | 1.085 | 1.091 | 1.098 | 1.104 | 1.111 | 42 |
| 48 | 1.111 | 1.117 | 1.124 | 1.130 | 1.137 | 1.144 | 1.150 | 41 |
| 49 | 1.150 | 1.157 | 1.164 | 1.171 | 1.178 | 1.185 | 1.192 | 40 |
| 50 | 1.192 | 1.199 | 1.206 | 1.213 | 1.220 | 1.228 | 1.235 | 39 |
| | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | |
| 51 | 1.235 | 1.242 | 1.250 | 1.257 | 1.265 | 1.272 | 1.280 | 38 |
| 52 | 1.280 | 1.288 | 1.295 | 1.303 | 1.311 | 1.319 | 1.327 | 37 |
| 53 | 1.327 | 1.335 | 1.343 | 1.351 | 1.360 | 1.368 | 1.376 | 36 |
| 54 | 1.376 | 1.385 | 1.393 | 1.402 | 1.411 | 1.419 | 1.428 | 35 |
| 55 | 1.428 | 1.437 | 1.446 | 1.455 | 1.464 | 1.473 | 1.483 | 34 |
| | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | |
| 56 | 1.483 | 1.492 | 1.501 | 1.511 | 1.520 | 1.530 | 1.540 | 33 |
| 57 | 1.540 | 1.550 | 1.560 | 1.570 | 1.580 | 1.590 | 1.600 | 32 |
| 58 | 1.600 | 1.611 | 1.621 | 1.632 | 1.643 | 1.653 | 1.664 | 31 |
| 59 | 1.664 | 1.675 | 1.686 | 1.698 | 1.709 | 1.720 | 1.732 | 30 |
| 60 | 1.732 | 1.744 | 1.756 | 1.767 | 1.780 | 1.792 | 1.804 | 29 |
| | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | |
| 61 | 1.804 | 1.816 | 1.829 | 1.842 | 1.855 | 1.868 | 1.881 | 28 |
| 62 | 1.881 | 1.894 | 1.907 | 1.921 | 1.935 | 1.949 | 1.963 | 27 |
| 63 | 1.963 | 1.977 | 1.991 | 2.006 | 2.020 | 2.035 | 2.050 | 26 |
| 64 | 2.050 | 2.066 | 2.081 | 2.097 | 2.112 | 2.128 | 2.145 | 25 |
| 65 | 2.145 | 2.161 | 2.177 | 2.194 | 2.211 | 2.229 | 2.246 | 24 |
| | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | |
| 66 | 2.246 | 2.264 | 2.282 | 2.300 | 2.318 | 2.337 | 2.356 | 23 |
| 67 | 2.356 | 2.375 | 2.394 | 2.414 | 2.434 | 2.455 | 2.475 | 22 |
| 68 | 2.475 | 2.496 | 2.517 | 2.539 | 2.560 | 2.583 | 2.605 | 21 |
| 69 | 2.605 | 2.628 | 2.651 | 2.675 | 2.699 | 2.723 | 2.748 | 20 |
| 70 | 2.748 | 2.773 | 2.798 | 2.824 | 2.850 | 2.877 | 2.904 | 19 |
| | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | |
| 71 | 2.904 | 2.932 | 2.960 | 2.989 | 3.018 | 3.047 | 3.078 | 18 |
| 72 | 3.078 | 3.108 | 3.140 | 3.172 | 3.204 | 3.237 | 3.271 | 17 |
| 73 | 3.271 | 3.305 | 3.340 | 3.376 | 3.412 | 3.450 | 3.487 | 16 |
| 74 | 3.487 | 3.526 | 3.566 | 3.606 | 3.647 | 3.689 | 3.732 | 15 |
| 75 | 3.732 | 3.776 | 3.821 | 3.867 | 3.914 | 3.962 | 4.011 | 14 |
| | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | |
| 76 | 4.011 | 4.061 | 4.113 | 4.165 | 4.219 | 4.275 | 4.332 | 13 |
| 77 | 4.332 | 4.390 | 4.449 | 4.511 | 4.574 | 4.638 | 4.705 | 12 |
| 78 | 4.705 | 4.773 | 4.843 | 4.915 | 4.989 | 5.066 | 5.145 | 11 |
| 79 | 5.145 | 5.226 | 5.309 | 5.396 | 5.485 | 5.576 | 5.671 | 10 |
| 80 | 5.671 | 5.769 | 5.871 | 5.976 | 6.084 | 6,197 | 6.314 | 9 |
| | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | |
| 81 | 6.314 | 6.435 | 6.561 | 6.691 | 6.827 | 6.968 | 7.115 | 8 |
| 82 | 7.115 | 7.269 | 7.429 | 7.596 | 7.770 | 7.953 | 8.144 | 7 |
| 83 | 8.144 | 8.345 | 8.556 | 8.777 | 9.010 | 9.255 | 9.514 | 6 |
| 84 | 9.514 | 9.788 | 10.08 | 10.39 | 10.71 | 11.06 | 11.43 | 5 |
| 85 | 11.43 | 11.83 | 12.25 | 12.71 | 13.20 | 13.73 | 14.30 | 4 |
| | 0′ | 10′ | 20′ | 30′ | 40′ | 50′ | 60′ | |
| 86 | 14.30 | 14.92 | 15.60 | 16.35 | 17.17 | 18.07 | 19.08 | 3 |
| 87 | 19.08 | 20.21 | 21.47 | 22.90 | 24.54 | 26.43 | 28.64 | 2 |
| 88 | 28.64 | 31.24 | 34.37 | 38.19 | 42.96 | 49.10 | 57.29 | 1 |
| 89 | 57.29 | 68.75 | 85.94 | 114.6 | 171.9 | 343.8 | | 0 |
| 90 | | | | | | | | |
| | 60′ | 50′ | 40′ | 30′ | 20′ | 10′ | 0′ | COT |

## MINUTES TO DEGREES (Hundredths)

(May be rounded off to tenths)

| Minutes | Degrees | Minutes | Degrees |
|---|---|---|---|
| 31 | .52 | 46 | .77 |
| 32 | .53 | 47 | .78 |
| 33 | .55 | 48 | .80 |
| 34 | .57 | 49 | .82 |
| 35 | .58 | 50 | .83 |
| 36 | .60 | 51 | .85 |
| 37 | .62 | 52 | .87 |
| 38 | .63 | 53 | .88 |
| 39 | .65 | 54 | .90 |
| 40 | .67 | 55 | .92 |
| 41 | .68 | 56 | .93 |
| 42 | .70 | 57 | .95 |
| 43 | .72 | 58 | .97 |
| 44 | .73 | 59 | .98 |
| 45 | .75 | 60 | 1.00 |
| Minutes | Degrees | Minutes | Degrees |

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# NATURAL FUNCTIONS

## MINUTES TO DEGREES (Hundredths)

(May be rounded off to tenths)

| Minutes | Degrees | Minutes | Degrees |
|---|---|---|---|
| 1 | 02 | 16 | .27 |
| 2 | 03 | 17 | .28 |
| 3 | 05 | 18 | .30 |
| 4 | 07 | 19 | .32 |
| 5 | 08 | 20 | .33 |
| 6 | 10 | 21 | .35 |
| 7 | 12 | 22 | .36 |
| 8 | 13 | 23 | .38 |
| 9 | 15 | 24 | .40 |
| 10 | 17 | 25 | .42 |
| 11 | 18 | 26 | .43 |
| 12 | 20 | 27 | .45 |
| 13 | 21 | 28 | .46 |
| 14 | 23 | 29 | .48 |
| 15 | 25 | 30 | .50 |
| Minutes | Degrees | Minutes | Degrees |

51-1

| SIN | 0' | 10 | 20 | 30 | 40 | 50 | 60 | |
|---|---|---|---|---|---|---|---|---|
| 0 | .0000 | .0029 | .0058 | .0087 | .0116 | .0145 | .0175 | 89 |
| 1 | .0175 | .0204 | .0233 | .0262 | .0291 | .0320 | .0349 | 88 |
| 2 | .0349 | .0378 | .0407 | .0436 | .0465 | .0494 | .0523 | 87 |
| 3 | .0523 | .0552 | .0581 | .0610 | .0640 | .0669 | .0698 | 86 |
| 4 | .0698 | .0727 | .0756 | .0785 | .0814 | .0843 | .0872 | 85 |
| 5 | .0872 | .0901 | .0929 | .0958 | .0987 | .1016 | .1045 | 84 |
| | 0' | 10' | 20 | 30 | 40 | 50' | 60' | |
| 6 | .1045 | .1074 | .1103 | .1132 | .1161 | .1190 | .1219 | 83 |
| 7 | .1219 | .1248 | .1276 | .1305 | .1334 | .1363 | .1392 | 82 |
| 8 | .1392 | .1421 | .1449 | .1478 | .1507 | .1536 | .1564 | 81 |
| 9 | .1564 | .1593 | .1622 | .1650 | .1679 | .1708 | .1736 | 80 |
| 10 | .1736 | .1765 | .1794 | .1822 | .1851 | .1880 | .1908 | 79 |
| | 0 | 10 | 20 | 30 | 40 | 50' | 60' | |
| 11 | .1908 | .1937 | .1965 | .1994 | .2022 | .2051 | .2079 | 78 |
| 12 | .2079 | .2108 | .2136 | .2164 | .2193 | .2221 | .2250 | 77 |
| 13 | .2250 | .2278 | .2306 | .2334 | .2363 | .2391 | .2419 | 76 |
| 14 | .2419 | .2447 | .2476 | .2504 | .2532 | .2560 | .2588 | 75 |
| 15 | .2588 | .2616 | .2644 | .2672 | .2700 | .2728 | .2756 | 74 |
| | 0 | 10 | 20 | 30 | 40 | 50 | 60 | |
| 16 | .2756 | .2784 | .2812 | .2840 | .2868 | .2896 | .2924 | 73 |
| 17 | .2924 | .2952 | .2979 | .3007 | .3035 | .3062 | .3090 | 72 |
| 18 | .3090 | .3118 | .3145 | .3173 | .3201 | .3228 | .3256 | 71 |
| 19 | .3256 | .3283 | .3311 | .3338 | .3365 | .3393 | .3420 | 70 |
| 20 | .3420 | .3448 | .3475 | .3502 | .3529 | .3557 | .3584 | 69 |
| | 0' | 10 | 20 | 30 | 40' | 50 | 60' | |
| 21 | .3584 | .3611 | .3638 | .3665 | .3692 | .3719 | .3746 | 68 |
| 22 | .3746 | .3773 | .3800 | .3827 | .3854 | .3881 | .3907 | 67 |
| 23 | .3907 | .3934 | .3961 | .3987 | .4014 | .4041 | .4067 | 66 |
| 24 | .4067 | .4094 | .4120 | .4147 | .4173 | .4200 | .4226 | 65 |
| 25 | .4226 | .4253 | .4279 | .4305 | .4331 | .4358 | .4384 | 64 |
| | 0' | 10 | 20 | 30 | 40 | 50 | 60 | |
| 26 | .4384 | .4410 | .4436 | .4462 | .4488 | .4514 | .4540 | 63 |
| 27 | .4540 | .4566 | .4592 | .4617 | .4643 | .4669 | .4695 | 62 |
| 28 | .4695 | .4720 | .4746 | .4772 | .4797 | .4823 | .4848 | 61 |
| 29 | .4848 | .4874 | .4899 | .4924 | .4950 | .4975 | .5000 | 60 |
| 30 | .5000 | .5025 | .5050 | .5075 | .5100 | .5125 | .5150 | 59 |
| | 0' | 10 | 20 | 30' | 40 | 50' | 60 | |
| 31 | .5150 | .5175 | .5200 | .5225 | .5250 | .5275 | .5299 | 58 |
| 32 | .5299 | .5324 | .5348 | .5373 | .5398 | .5422 | .5446 | 57 |
| 33 | .5446 | .5471 | .5495 | .5519 | .5544 | .5568 | .5592 | 56 |
| 34 | .5592 | .5616 | .5640 | .5664 | .5688 | .5712 | .5736 | 55 |
| 35 | .5736 | .5760 | .5783 | .5807 | .5831 | .5854 | .5878 | 54 |
| | 0' | 10 | 20' | 30' | 40 | 50 | 60' | |
| 36 | .5878 | .5901 | .5925 | .5948 | .5972 | .5995 | .6018 | 53 |
| 37 | .6018 | .6041 | .6065 | .6088 | .6111 | .6134 | .6157 | 52 |
| 38 | .6157 | .6180 | .6202 | .6225 | .6248 | .6271 | .6293 | 51 |
| 39 | .6293 | .6316 | .6338 | .6361 | .6383 | .6406 | .6428 | 50 |
| 40 | .6428 | .6450 | .6472 | .6494 | .6517 | .6539 | .6561 | 49 |
| | 0 | 10' | 20 | 30 | 40 | 50' | 60 | |
| 41 | .6561 | .6583 | .6604 | .6626 | .6648 | .6670 | .6691 | 48 |
| 42 | .6691 | .6713 | .6734 | .6756 | .6777 | .6799 | .6820 | 47 |
| 43 | .6820 | .6841 | .6862 | .6884 | .6905 | .6926 | .6947 | 46 |
| 44 | .6947 | .6967 | .6988 | .7009 | .7030 | .7050 | .7071 | 45 |
| 45 | .7071 | .7092 | .7112 | .7133 | .7153 | .7173 | .7193 | 44 |
| | 60 | 50' | 40 | 30' | 20' | 10' | 0' | COS |

| SIN | 0' | 10' | 20' | 30' | 40' | 50' | 60' | |
|---|---|---|---|---|---|---|---|---|
| 46 | .7193 | .7214 | .7234 | .7254 | .7274 | .7294 | .7314 | 43 |
| 47 | .7314 | .7333 | .7353 | .7373 | .7392 | .7412 | .7431 | 42 |
| 48 | .7431 | .7451 | .7470 | .7490 | .7509 | .7528 | .7547 | 41 |
| 49 | .7547 | .7566 | .7585 | .7604 | .7623 | .7642 | .7660 | 40 |
| 50 | .7660 | .7679 | .7698 | .7716 | .7735 | .7753 | .7771 | 39 |
| | 0' | 10' | 20' | 30' | 40' | 50' | 60' | |
| 51 | .7771 | .7790 | .7808 | .7826 | .7844 | .7862 | .7880 | 38 |
| 52 | .7880 | .7898 | .7916 | .7934 | .7951 | .7969 | .7986 | 37 |
| 53 | .7986 | .8004 | .8021 | [illegible] | .8056 | .8073 | .8090 | 36 |
| 54 | .8090 | .8107 | .8124 | .8141 | .8158 | .8175 | .8192 | 35 |
| 55 | .8192 | .8208 | .8225 | .8241 | .8258 | .8274 | .8290 | 34 |
| | 0' | 10' | 20' | 30' | 40' | 50' | 60' | |
| 56 | .8290 | .8307 | .8323 | .8339 | .8355 | .8371 | .8387 | 33 |
| 57 | .8387 | .8403 | .8418 | .8434 | .8450 | .8465 | .8480 | 32 |
| 58 | .8480 | .8496 | .8511 | .8526 | .8542 | .8557 | .8572 | 31 |
| 59 | .8572 | .8587 | .8601 | .8616 | .8631 | .8646 | .8660 | 30 |
| 60 | .8660 | .8675 | .8689 | .8704 | .8718 | .8732 | .8746 | 29 |
| | 0' | 10' | 20' | 30' | 40' | 50' | 60' | |
| 61 | .8746 | .8760 | .8774 | .8788 | .8802 | .8816 | .8829 | 28 |
| 62 | .8829 | .8843 | .8857 | .8870 | .8884 | .8897 | .8910 | 27 |
| 63 | .8910 | .8923 | .8936 | .8949 | .8962 | .8975 | .8988 | 26 |
| 64 | .8988 | .9001 | .9013 | .9026 | .9038 | .9051 | .9063 | 25 |
| 65 | .9063 | .9075 | .9088 | .9100 | .9112 | .9124 | .9135 | 24 |
| | 0' | 10' | 20' | 30' | 40' | 50' | 60' | |
| 66 | .9135 | .9147 | .9159 | .9171 | .9182 | .9194 | .9205 | 23 |
| 67 | .9205 | .9216 | .9228 | .9239 | .9250 | 9261 | .9272 | 22 |
| 68 | .9272 | .9283 | .9293 | .9304 | .9315 | .9325 | .9336 | 21 |
| 69 | .9336 | .9346 | .9356 | .9367 | .9377 | .9387 | .9397 | 20 |
| 70 | .9397 | .9407 | .9417 | .9426 | .9436 | .9446 | .9455 | 19 |
| | 0' | 10' | 20' | 30' | 40' | 50' | 60' | |
| 71 | .9455 | .9465 | .9474 | .9483 | .9492 | .9502 | .9511 | 18 |
| 72 | .9511 | .9520 | .9528 | .9537 | .9546 | .9555 | .9563 | 17 |
| 73 | .9563 | .9572 | .9580 | .9588 | .9596 | .9605 | .9613 | 16 |
| 74 | .9613 | .9621 | .9628 | .9636 | .9644 | .9652 | .9659 | 15 |
| 75 | .9659 | .9667 | .9674 | .9681 | .9689 | .9698 | .9703 | 14 |
| | 0' | 10' | 20' | 30' | 40' | 50' | 60' | |
| 76 | .9703 | .9710 | .9717 | .9724 | .9730 | .9737 | .9744 | 13 |
| 77 | .9744 | .9750 | .9757 | .9763 | .9769 | .9775 | .9781 | 12 |
| 78 | .9781 | .9787 | .9793 | .9799 | .9805 | .9811 | .9816 | 11 |
| 79 | .9816 | .9822 | .9827 | .9833 | .9838 | .9843 | .9848 | 10 |
| 80 | .9848 | .9853 | .9858 | .9863 | .9868 | .9872 | .9877 | 9 |
| | 0' | 10' | 20' | 30' | 40' | 50' | 60' | |
| 81 | .9877 | .9881 | .9886 | .9890 | .9894 | .9899 | .9903 | 8 |
| 82 | .9903 | .9907 | .9911 | .9914 | .9918 | .9922 | .9925 | 7 |
| 83 | .9925 | .9929 | .9932 | .9936 | .9939 | .9942 | .9945 | 6 |
| 84 | .9945 | .9948 | [illegible] | .9954 | .9957 | .9959 | .9962 | 5 |
| 85 | .9962 | .9964 | [illegible] | .9969 | .9971 | .9974 | .9976 | 4 |
| | 0' | 10' | 20' | 30' | 40' | 50' | 60' | |
| 86 | .9976 | .9978 | [illegible] | .9981 | .9983 | .9985 | .9986 | 3 |
| 87 | .9986 | .9988 | [illegible] | .9990 | .9992 | .9993 | .9994 | 2 |
| 88 | .9994 | .9995 | .9996 | .9997 | .9997 | .9998 | .9998 | 1 |
| 89 | .9998 | .9999 | .9999 | 1.000 | 1.000 | 1.000 | 1.000 | 0 |
| 90 | 1.000 | | | | | | | |
| | 60' | 50' | 40' | 30' | 20' | 10' | 0' | COS |

## MINUTES TO DEGREES (Hundredths)

(May be rounded off to tenths)

| Minutes | Degrees | Minutes | Degrees |
|---|---|---|---|
| 31 | .52 | 46 | .77 |
| 32 | .53 | 47 | .78 |
| 33 | .55 | 48 | .80 |
| 34 | .57 | 49 | .82 |
| 35 | .58 | 50 | .83 |
| 36 | .60 | 51 | .85 |
| 37 | .62 | 52 | .87 |
| 38 | .63 | 53 | .88 |
| 39 | .65 | 54 | .90 |
| 40 | .67 | 55 | .92 |
| 41 | .68 | 56 | .93 |
| 42 | .70 | 57 | .95 |
| 43 | .72 | 58 | .97 |
| 44 | .73 | 59 | .98 |
| 45 | .75 | 60 | 1.00 |
| Minutes | Degrees | Minutes | Degrees |

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## 5. TABLE OF LAP AND WASTE ALLOWANCES FOR LAP SIDING

| WIDTH | EXPOSURE TO WEATHER | ADD FOR LAP AND WASTE |
|---|---|---|
| 12" | 10 1/2" | 15% |
| 12" | 10" | 20% |
| 10" | 8 1/2" | 18% |
| 10" | 8" | 24% |
| 8" | 6 1/2" | 23% |
| 6" | 5" | 25% |
| 6" | 4 3/4" | 32% |
| 6" | 4 1/2" | 38% |
| 4" | 2 3/4" | 51% |
| 4" | 2 1/2" | 65% |

a) How much more 4" siding will be needed for a 2 1/2" exposure than a 2 3/4" exposure?

b) How much is the lap and waste allowance for 12" lap siding with a 10" weather exposure?

c) What is the amount to add for lap and waste when 8" is exposed on 10" lap siding?

d) If a homeowner wishes to use 12" siding with 10 1/2" exposed, instead of using 10" siding with 8" exposed, how much less siding will it take to do the job?

e) What is the exposure of 12" siding if the waste and lap allowance is 15%?

f) The exposure of 2 3/4" for 4" siding has a waste and lap factor of 51%. What is the factor for 6" siding with an exposure of 4 3/4"?

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Interpolate to find information missing from a table.

## PERFORMANCE OBJECTIVE #52

Given a table, interpolate to find a value between two given values.

## SAMPLE ITEM

What is the CFM air delivery for .45 inches pressure? (ans: 780 CFM)

| External Static Pressure Inches Water Column | CFM Air Delivery |
|---|---|
| .5 | 740 |
| .4 | 820 |
| .3 | 880 |

## NOTES

Interpolation is essential when reading tables even though we frequently estimate rather than doing a formal calculation.

## EVALUATION

| Depth of Water in Feet | Water Pressure in PSI |
|---|---|
| 4 | 1.73 |
| 8 | 3.46 |
| 12 | 5.19 |

1. What is the water pressure in PSI at:
   a) 5 feet
   b) 10 feet

2. How deep is the water when the pressure PSI is:
   a) 4
   b) 5

## ANSWERS TO EVALUATION

1. a) 2.16 PSI
   b) 4.33 PSI

2. a) 9.25 ft.
   b) 11.56 ft.

## ANSWERS TO APPLICATIONS

1. 22.8 BTU/sq. ft.

2. 16.8 BTU/sq. ft.

3. 51.8 BTU/sq. ft.

4. a) 13.77"
   b) 15.31"
   c) 15.79"
   d) 17.11"

5. a) .4152
   b) .3670

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #52

Performance Objective #52: Given a table, interpolate to find a value between two given values.

## TABLE 2
## HEAT TRANSFER MULTIPLIERS

| Wood and Metal Doors. Factors include heat loss due to transmission and infiltration @ 15. MPH | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Winter Temperature Difference | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 | UT | UE |
| No. 10 Doors. Crack Ratio = 1.0:1.0. Infiltration Rate = 0.5 CFM/LF @ 25 MPH | (Btuh per sq. ft.) | | | | | | | | | | | | | | | | |
| A. Solid Wood | 21.4 | 25.0 | 28.5 | 32.1 | 35.6 | 39.2 | 42.3 | 46.3 | 49.9 | 53.5 | 57.0 | 60.6 | 64.2 | 67.7 | 71.3 | 0.460 | 0.713 |
| B. Solid Wood + Storm Door | 15.0 | 17.5 | 20.0 | 22.5 | 25.0 | 27.4 | 29.9 | 32.4 | 34.9 | 37.4 | 39.9 | 42.4 | 44.9 | 47.4 | 49.9 | 0.309 | 0.499 |
| C. Metal-Fiber Core | 25.3 | 29.5 | 33.7 | 37.9 | 42.2 | 46.4 | 50.6 | 54.8 | 59.0 | 63.2 | 67.4 | 71.7 | 75.9 | 80.1 | 84.3 | 0.509 | 0.843 |
| D. Metal-Fiber Core + Storm Door | 16.7 | 19.5 | 22.3 | 25.1 | 27.8 | 30.6 | 33.4 | 36.2 | 39.0 | 41.8 | 44.6 | 47.3 | 50.1 | 52.9 | 55.7 | 0.367 | 0.557 |
| E. Metal-Urethane Core | 13.3 | 15.5 | 17.7 | 19.9 | 22.1 | 24.4 | 26.6 | 28.8 | 31.0 | 33.2 | 35.4 | 37.7 | 39.9 | 42.1 | 44.3 | 0.190 | 0.443 |
| F. Metal-Urethane Core + Storm Door | 10.5 | 12.3 | 14.0 | 15.8 | 17.5 | 19.3 | 21.0 | 22.8 | 24.5 | 26.3 | 28.0 | 29.8 | 31.5 | 33.3 | 35.0 | 0.160 | 0.350 |
| G. Metal-Polystyrene Core | 21.7 | 25.3 | 28.9 | 32.5 | 36.1 | 39.8 | 43.4 | 47.0 | 50.6 | 54.2 | 57.8 | 61.5 | 65.1 | 68.7 | 72.3 | 0.470 | 0.723 |
| H. Metal-Polystyrene Core + Storm | 15.3 | 17.8 | 20.4 | 22.9 | 25.5 | 28.0 | 30.5 | 33.1 | 35.6 | 38.2 | 40.7 | 43.3 | 45.8 | 48.4 | 50.9 | 0.317 | 0.509 |
| No. 11 Doors. Crack Ratio = 1.0:1.0. Infiltration Rate = 1.0 CFM/LF @ 25 MPH | (Btuh per sq. ft.) | | | | | | | | | | | | | | | | |
| A. Solid Wood | 30.6 | 35.7 | 40.8 | 45.9 | 51.0 | 56.2 | 61.3 | 66.4 | 71.5 | 76.6 | 81.7 | 86.8 | 91.9 | 97.0 | 102.1 | 0.460 | 1.021 |
| B. Solid Wood + Storm Door | 17.7 | 20.7 | 23.6 | 26.5 | 29.5 | 32.4 | 35.4 | 38.3 | 41.3 | 44.3 | 47.2 | 50.2 | 53.1 | 56.1 | 59.0 | 0.309 | 0.590 |
| C. Metal-Fiber Core | 34.5 | 40.3 | 46.0 | 51.8 | 57.5 | 63.3 | 69.1 | 74.8 | 80.6 | 86.3 | 92.1 | 97.8 | 103.6 | 109.3 | 115.1 | 0.590 | 1.151 |
| D. Metal-Fiber Core + Storm Door | 19.4 | 22.7 | 25.9 | 29.2 | 32.4 | 35.6 | 38.9 | 42.1 | 45.4 | 48.6 | 51.8 | 55.1 | 58.3 | 61.6 | 64.8 | 0.367 | 0.648 |
| E. Metal-Urethane Core | 22.5 | 26.3 | 30.0 | 33.8 | 37.5 | 41.3 | 45.1 | 48.8 | 52.6 | 56.3 | 60.1 | 63.8 | 67.6 | 71.3 | 75.1 | 0.190 | 0.751 |
| F. Metal-Urethane Core + Storm Door | 13.2 | 15.4 | 17.6 | 19.8 | 22.0 | 24.3 | 26.5 | 28.7 | 30.9 | 33.1 | 35.3 | 37.5 | 39.7 | 41.9 | 44.1 | 0.160 | 0.441 |
| G. Metal-Polystyrene Core | 30.9 | 36.1 | 41.2 | 46.4 | 51.5 | 56.7 | 61.9 | 67.0 | 72.2 | 77.3 | 82.5 | 87.6 | 92.8 | 97.9 | 103.1 | 0.470 | 1.031 |
| H. Metal-Polystyrene Core + Storm | 17.9 | 20.9 | 23.9 | 26.9 | 29.9 | 32.9 | 35.9 | 38.9 | 41.9 | 44.8 | 47.8 | 50.8 | 53.8 | 56.8 | 59.8 | 0.317 | 0.598 |

1. From Section No. 10, Table 2 find the HTM for solid wood and a temperature difference of 32°F.

2. From Section No. 10, Table 2 find the HTM for a metal door - urethane core plus storm door at 48°F.

3. From Section No. 11, Table 2 find the HTM for a metal door with a urethane core at 69°F.

4. In the Rafter Table below, the lengths of common rafters are shown for risers per foot of run of 6" to 15". If the rise per foot of run is a mixed number, interpolation must be accomplished to determine the length of the common rafter per foot of run.

### LENGTH OF COMMON RAFTER PER FOOT OF RUN

| Rise Per Ft. of Run | Length of Common Rafter |
|---|---|
| 6" | 13.42" |
| 7" | 13.89" |
| 8" | 14.42" |
| 9" | 15.0" |
| 10" | 15.62" |
| 11" | 16.28" |
| 12" | 16.97" |
| 13" | 17.69" |
| 14" | 18.44" |
| 15" | 19.21" |

Using the table above, determine through interpolation the lengths of common rafters per foot of run when the rise is: (round off to two decimal places)

a) $6\frac{3}{4}$"

b) $9\frac{1}{2}$"

c) $10\frac{1}{4}$"

d) 12.2"

5. Using trigonometric function tables (such as the one attached to Performance Objective #51) find:

a) sin 24° 32'
b) cos 68° 18'

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Read and interpret line, bar and circle graphs.

## PERFORMANCE OBJECTIVE #53

Given a line graph, answer questions pertaining to the information in the graph.

## NOTES

As graphs are studied, students should learn not only to read information directly but to use the information to make better decisions.

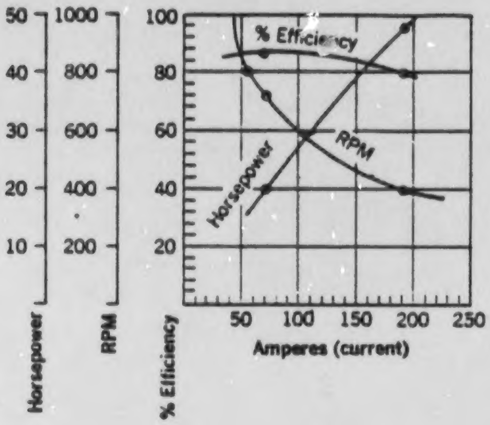
## REFERENCE TO TEXT

**Applied General Mathematics** (AGM), pages 253-273

## EVALUATION

1. At maximum efficiency, what is the:
   a) RPM?
   b) horsepower?

2. Find the current, efficiency, and horsepower for a speed of 600 rpm.



## ANSWERS TO EVALUATION

1. a) 720 RPM
   b) 20 HP
2. Current = 100 amps; efficiency 88-90%; horsepower = 28

## ANSWERS TO APPLICATIONS

1. a) 7.8 HP
   b) 80%
   c) 1.85 in W.C.
2. a) 22,000 BTUH
   b) 12,500 BTUH
   c) 11,000 BTUH
   d) 8,000 BTUH
3. a) 4,700 FPM
   b) 1,875 FPM
   c) 3,600 FPM
   d) 1,450 FPM
   e) 2,700 FPM
4. a) 800
   b) 750
   c) 725
   d) 775
   e) 5,325
   f) 50

5. a) Price of one-half inch 3-ply 4' x 8' plywood
   b) Cost in dollars
   c) 1982 - 83
6. a) $13,000
   b) $5,000
   c) September ($87,000)

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #53

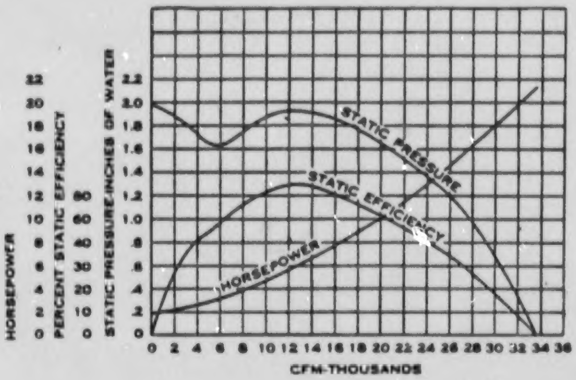
Performance Objective #53: Given a line graph, answer questions pertaining to the information in the graph.

1. An air conditioning fan with forward curved blades is running at a speed to move 16,000 cubic feet of air per minute. Find the following.

   a) Horsepower required

   b) % static efficiency

   c) Static pressure



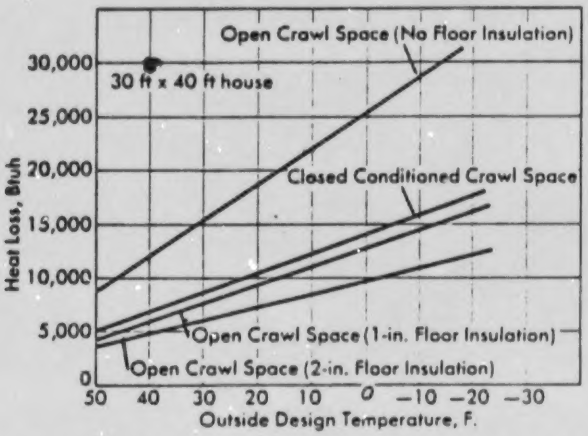
2. What will be the heat loss, in BTUH, with an outside design temperature of +10°F for the following conditions?

   a) Open crawl space with no floor insulation

   b) Closed conditioned crawl space

   c) Open crawl space with 1" floor insulation

   d) Open crawl space with 2" floor insulation



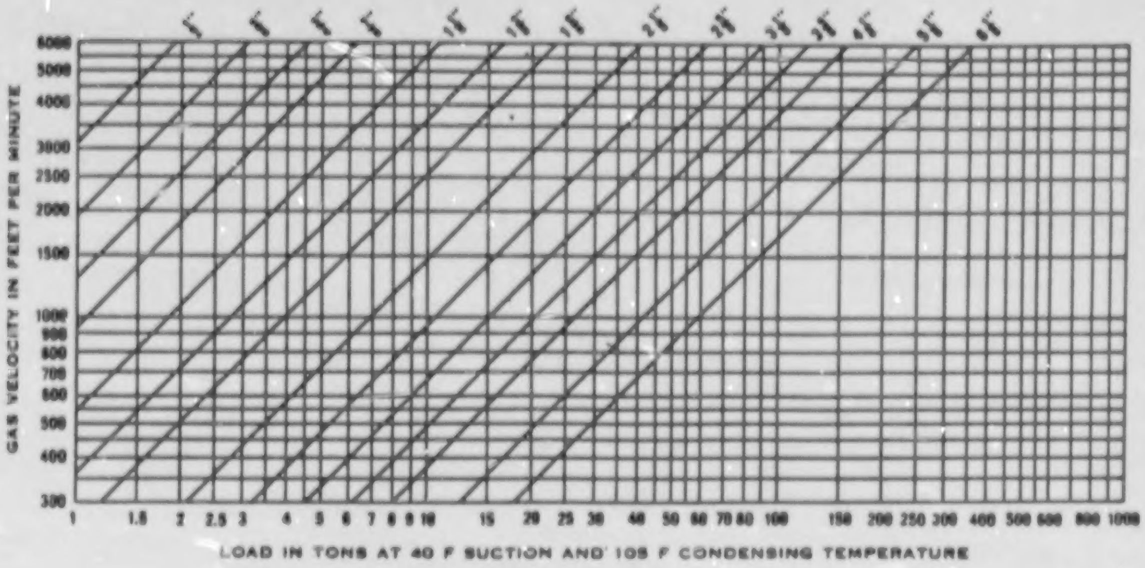
4-1 Comparison of below-floor heat losses for crawl-space structure.

3. Type "L" copper tubing is used to connect the compressor to the evaporator. The compressor is operating at 40°F suction temperature. What will be the suction gas velocity for the following load and tubing size combinations?

| | Tons | Tubing Size (in) | Velocity (FPM) |
|---|---|---|---|
| a. | 1.5 | 1/2 | ________ |
| b. | 1.5 | 3/4 | ________ |
| c. | 10 | 1 3/8 | ________ |
| d. | 10 | 2 1/8 | ________ |
| e. | 40 | 3 1/8 | ________ |

**Suction Gas Velocities for Refrigerant-12**

OUTSIDE DIAMETER-TYPE L COPPER TUBING



4. Referring to the following graph, answer these questions. (NOTE: Answers should be correct to nearest 25.)

   a) How many houses were constructed in 1976?

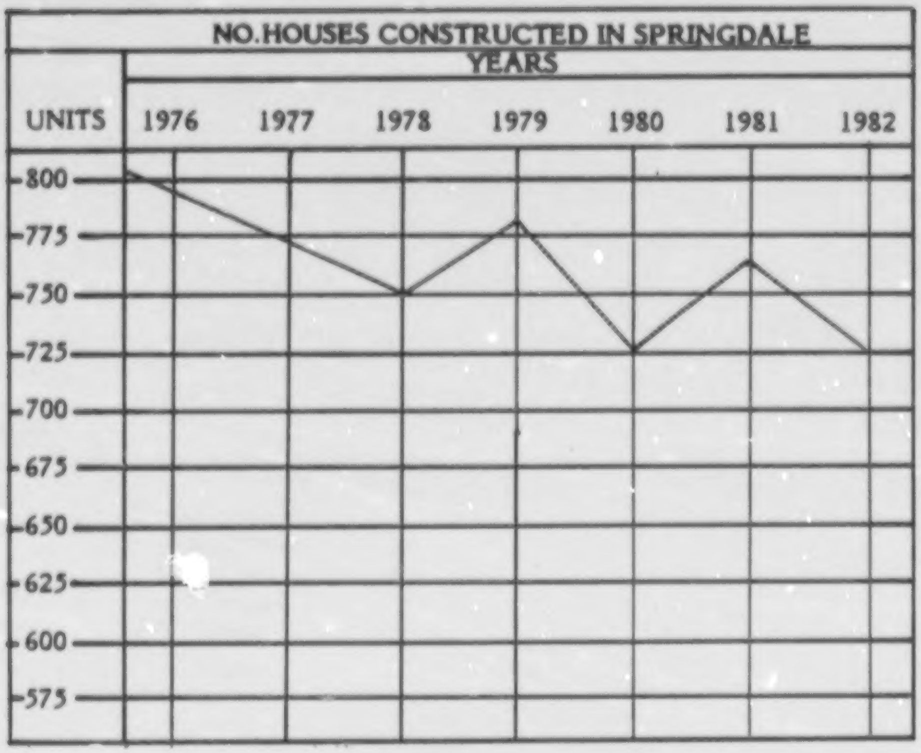
   b) In 1978?

   c) In 1982?

   d) In 1979?

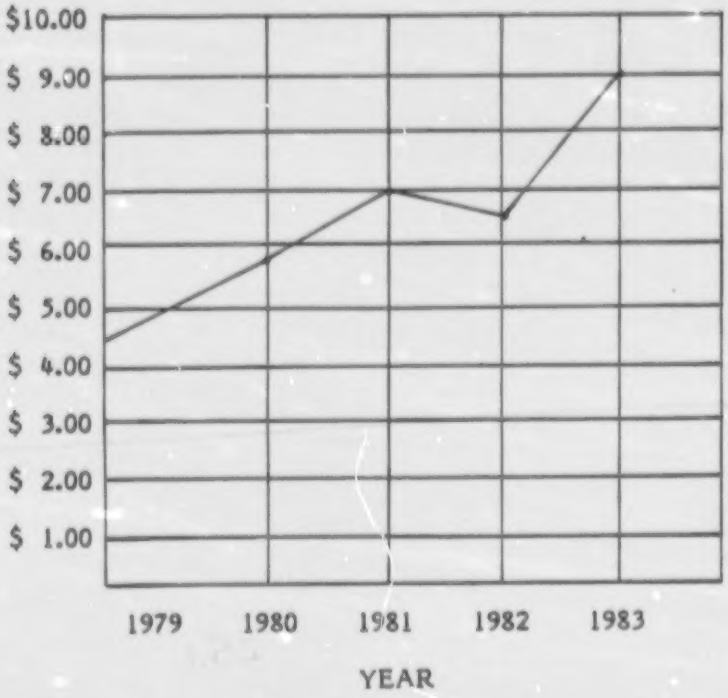
   e) From 1976 and 1982 inclusive?

   f) How many more houses were constructed in Springdale in 1981 than in 1980?



PRICE OF ONE-HALF INCH 3 PLY 4' x 8' PLYWOOD

5.



a) What is the title of the graph?

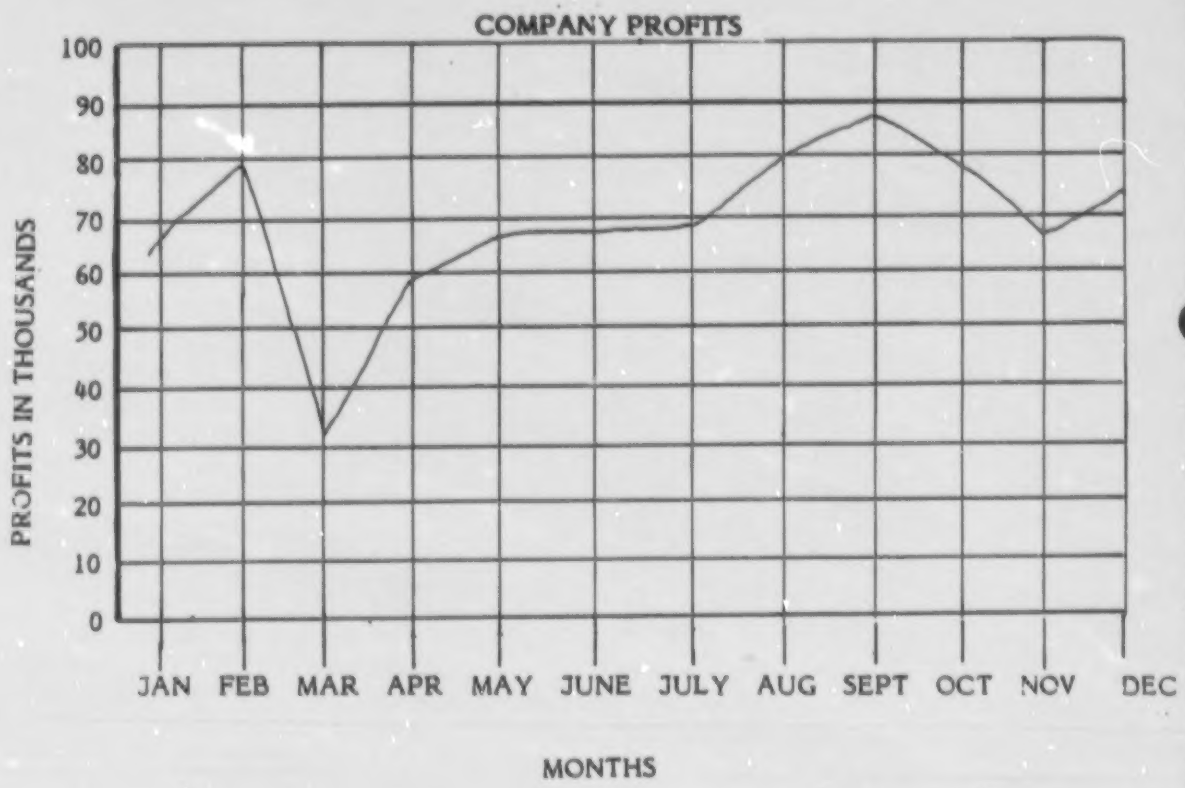
b) What do the vertical markings show?

c) In what period was the greatest increase in price?

6. a) What was the difference between January profits and February profits?

b) What is the difference between May profits and December profits?

c) What month had the biggest profit and how much?



# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

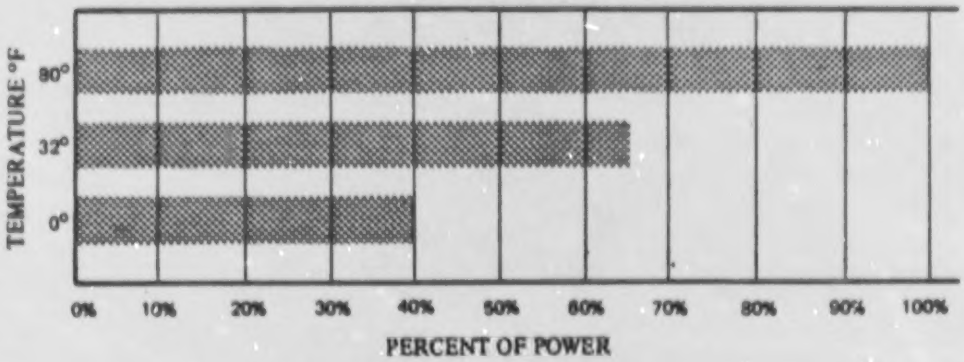
Read and interpret line, bar and circle graphs.

## PERFORMANCE OBJECTIVE #54

Given a bar graph, answer questions pertaining to the information in the graph.

## SAMPLE ITEM

What is the cranking power at freezing (32°F)? (ans. 65%)


CRANKING POWER OF BATTERY

## NOTES

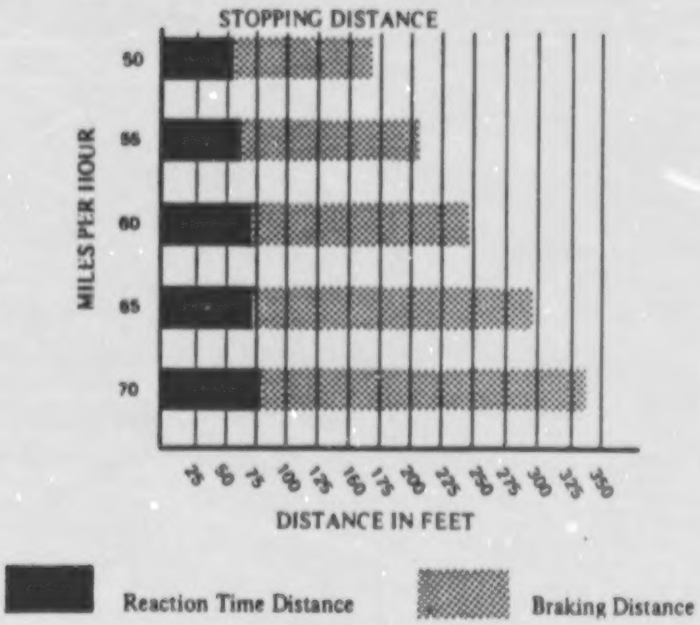
Students should be able to distinguish the kind of information given in a bar graph from the information in a line graph. The bar graph is easier to read than the line graph because each item of information is usually represented by a single bar. On line graphs, several items may be represented on a single line.

## REFERENCE TO TEXT

Applied General Mathematics (AGM), pages 240-252

## EVALUATION

1. a) What is the total stopping distance at 55 MPH?
   b) Of this, what is the reaction distance?
   c) What is the actual braking distance?
2. At what speed is the total stopping distance at 290 feet?
3. What is the total stopping distance for 70 MPH?


STOPPING DISTANCE
MILES PER HOUR
50
55
60
65
70
25
50
75
100
125
150
175
200
225
250
275
300
325
350
DISTANCE IN FEET
Reaction Time Distance
Braking Distance

## ANSWERS TO EVALUATION

1. a) Approx. 210 ft.
   b) 62 ft.
   c) Approx. 148 ft.
2. 65 mph
3. 337 ft.

## ANSWERS TO APPLICATIONS

1. a) 1981 to 1982
   b) 4 million
   c) 1982 - 83
2. a) 1973 to 1981; $290,000
   b) $100,000
   c) $25,000
3. Enrollment was 175 in 1979; in 1982 the enrollment was 250, an increase of 75.

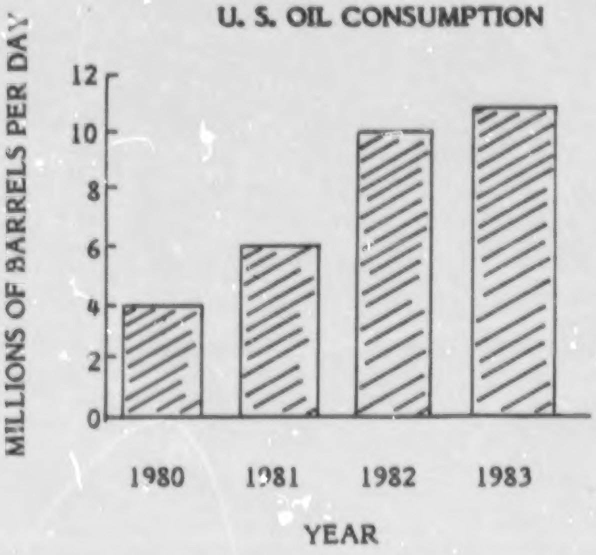
# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #54

Performance Objective #54: Given a bar graph, answer questions pertaining to the information in the graph.

1. a) Between which years did consumption increase the most?

   b) By how much?

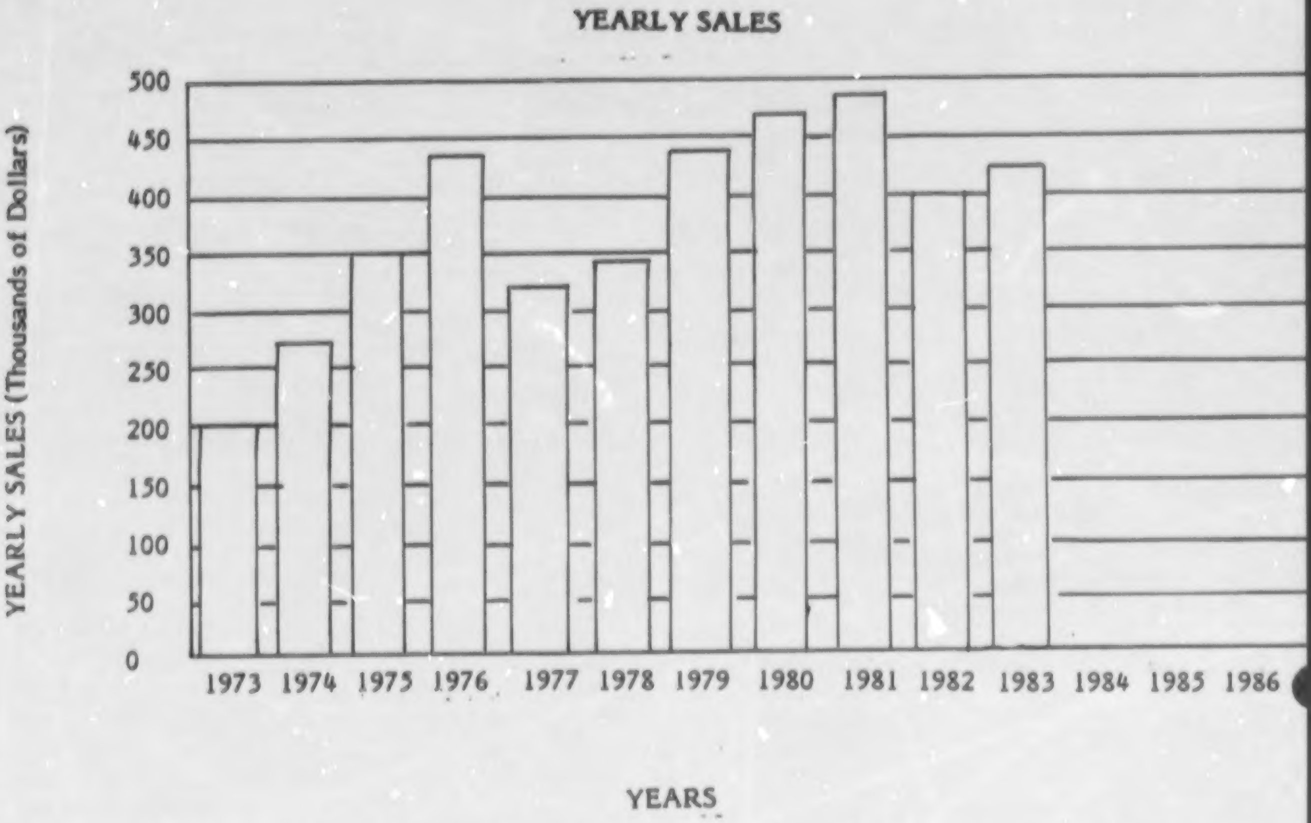
   c) Between which years did consumption increase the least?



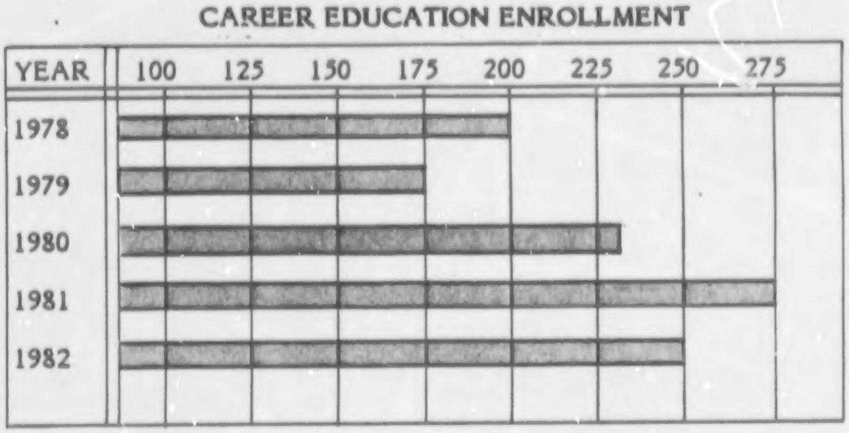
2. a) What was the difference in yearly sales in the highest and lowest years?

   b) What was the difference in 1978 sales and 1983 sales?

   c) What was the difference in sales from 1976 to 1982?



3. At Hampton High School, the career education enrollment during the past 5 years is shown on the bar graph. How many more students were enrolled in 1982 than in 1979?



# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

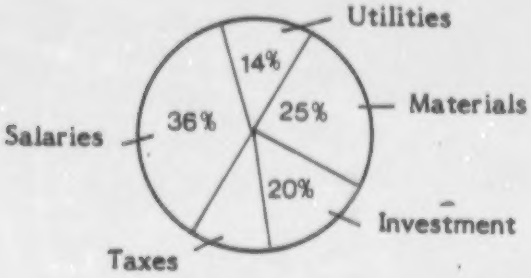
Read and interpret line, bar and circle graphs.

## PERFORMANCE OBJECTIVE #55

Given a circle graph, answer questions pertaining to the information in the graph.

## SAMPLE ITEM

If a company had $80,000 in expenditures, how much did it spend on materials?
(ans. $20,000)



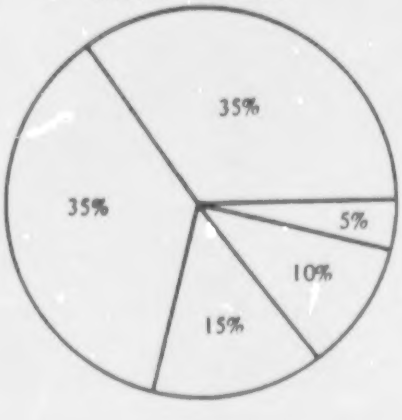
EXPENDITURES

## NOTES

The circle graph is used to show parts or percents of the whole (100%). The visual effect of the circle graph makes it easy to read and interpret.

## EVALUATION

1. What is the total percent of energy lost?
2. How much more energy is lost in exhaust gas than in engine friction?
3. About 1/10 of the energy is lost by what means?
4. The largest losses of energy are due to what?



GASOLINE ENERGY

## ANSWERS TO EVALUATION

1. 85%
2. 30%
3. power train
4. loss in cooling water, air and oil, and loss in exhaust gas

## ANSWERS TO APPLICATIONS

1. a) Materials
   b) 56%
   c) 32%
2. a) 40%
   b) 6%
   c) 28%
3. a) 15% more
   b) $86,000
   c) $344,000
   d) 54°

|  |  |  | Degrees | Amount |
|---|---|---|---|---|
| 4. | a) | Food 21% | 75° | $142.80 |
|  | b) | Clothing 3% | 11° | 20.40 |
|  | c) | Housing 36% | 130° | 244.80 |
|  | d) | Automobile 20% | 72° | 136.00 |
|  | e) | Medical 5% | 18° | 34.00 |
|  | f) | Misc. 15% | 54° | 102.00 |

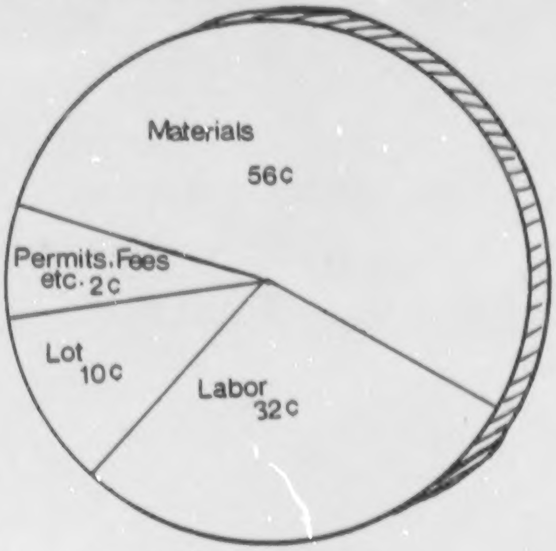
## APPLICATIONS
## FOR
## PERFORMANCE OBJECTIVE #55

Performance Objective #55: Given a circle graph, answer questions pertaining to the information in the graph.

1. a) What presents the largest part of the cost of a new home?

   b) What percent of the total is this cost?

   c) What percent of the total cost is labor?



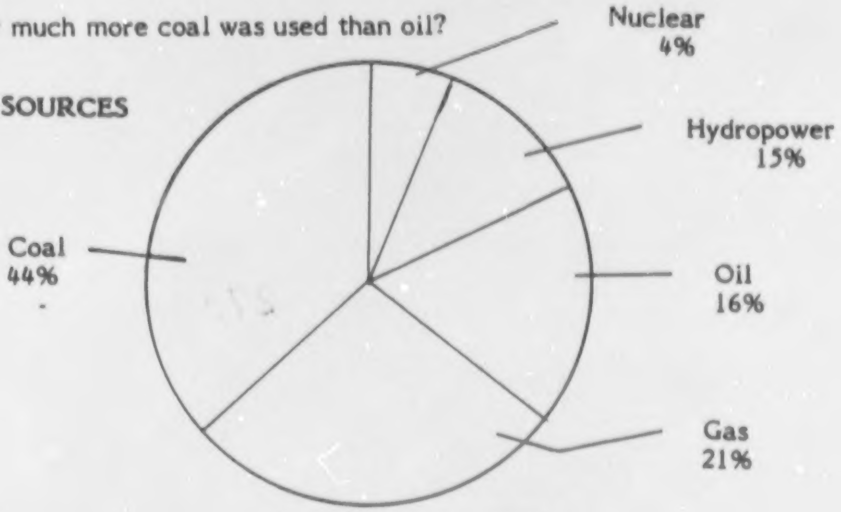
COST OF A NEW HOME

2. a) What is the difference between coal usage and nuclear usage?

   b) How much more gas was used than hydropower?

   c) How much more coal was used than oil?

ENERGY SOURCES



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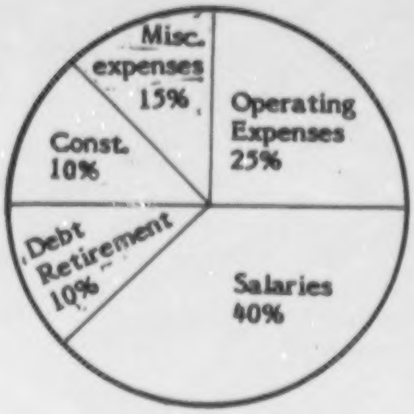


BUDGET FOR FISCAL YEAR '83

TOWN OF SALEM

TOTAL BUDGET: $860,000.00

3. Using the circle graph above, determine answers to the following questions:

   a) How much more (%) was spent for salaries than for operating expenses?

   b) How many dollars were spent for debt retirement?

   c) How many dollars were spent for salaries?

   d) How many degrees of arc are represented by 15% of the circle?

4. Construct a circle graph 4" in diameter. Draw radii from center of circle to create sectors accurate within 1 degree. The instructor will measure sectors with a protractor to check accuracy. Graphically represent the following information in the circle.

   Title: **Family Budget**
   Total amount: $680 monthly (100%)

   a) Food 21%

   b) Clothing 3%

   c) Housing 36%

   d) Automobile 20%

   e) Medical 5%

   f) Misc. 15%

# geometry

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCIES

Identify perpendicular lines.
Identify parallel lines.

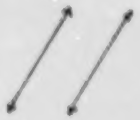
## PERFORMANCE OBJECTIVE #56

Given pairs of parallel and perpendicular lines, identify each.

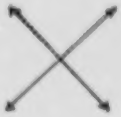
## SAMPLE ITEM

Identify each pair of lines as parallel or perpendicular.

a)



b)



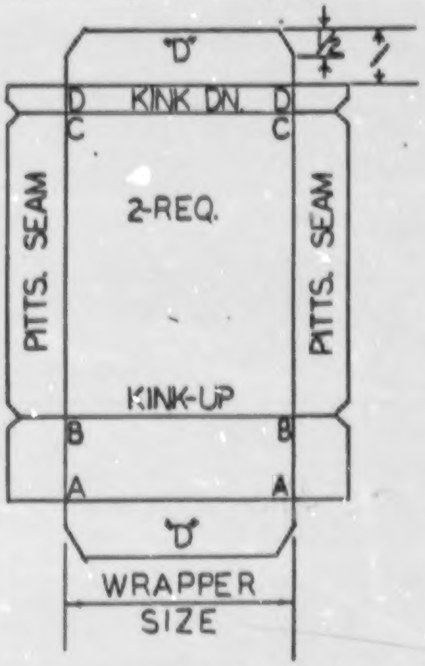
ans: a) parallel
b) perpendicular

## NOTES

Parallel and perpendicular lines are used in blue prints, drawings and all construction. These terms are also used in the installation of duct, pipe, and equipment.

## EVALUATION

Replace the ? with parallel or perpendicular ( $\parallel$ or $\perp$ )



HEEL PATTERN

1. $\overline{BC}$ ? $\overline{BB}$
2. $\overline{BC}$ ? $\overline{AD}$
3. $\overline{AA}$ ? $\overline{BB}$
4. $\overline{AA}$ ? $\overline{AB}$

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## ANSWERS TO EVALUATION

1. $\perp$
2. $\parallel$
3. $\parallel$
4. $\perp$

## ANSWERS TO APPLICATIONS

1. Parallel: DD, CC; CC, BB; BB, AA; AB, AB
   Perpendicular: BA, AA; AB, BB; FE, BB; FF, CC

2. Parallel: HG, AD; AB, DE, HC, FG
   Perpendicular: HC, BC; DE, EF; AB, AD; EF, AB; FG, HG

3. Parallel: EF, AB; AE, BF; AA, BB
   Perpendicular: FE, EA; DC, AA; DC, BB; EF, BF; AB, BF

4. a) perpendicular
   b) neither
   c) parallel

5. AB $\parallel$ DC; AD $\parallel$ BC

6. AB $\parallel$ DC

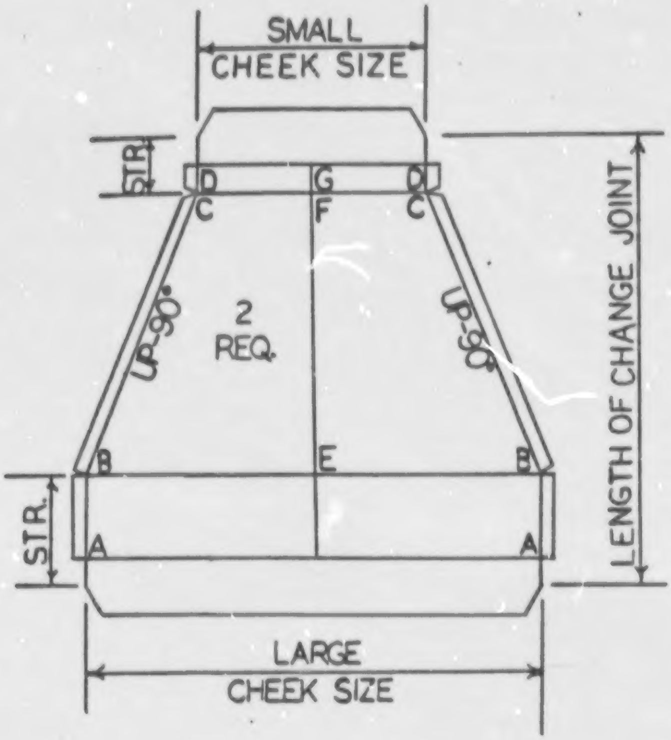
7. AB, HG; EF, HG; CB, DE; AH, FG; CD, HG

## APPLICATIONS
## FOR
## PERFORMANCE OBJECTIVE #56

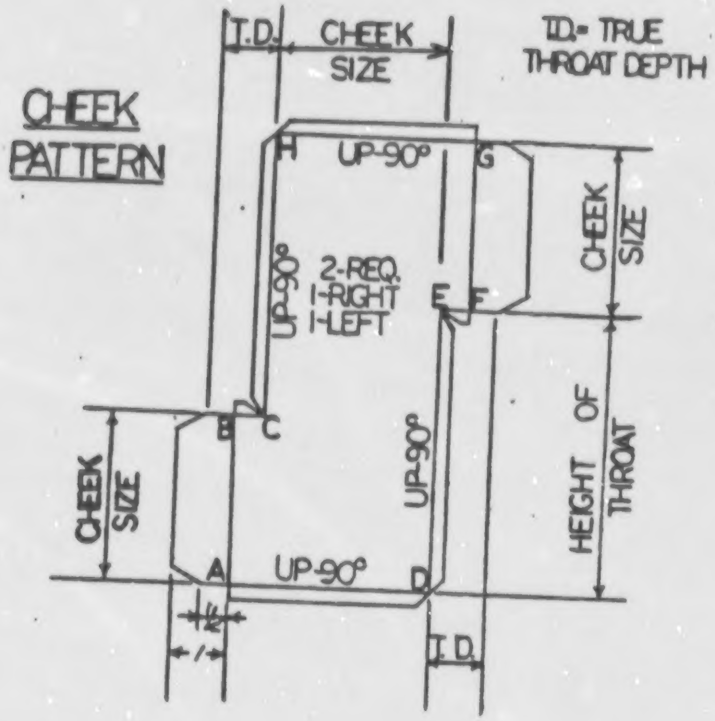
Performance Objective #56: Given pairs of parallel and perpendicular lines, identify each.

On the three drawings which follow, identify pairs of lines that are parallel and perpendicular. Example: Line CC is parallel to DD.

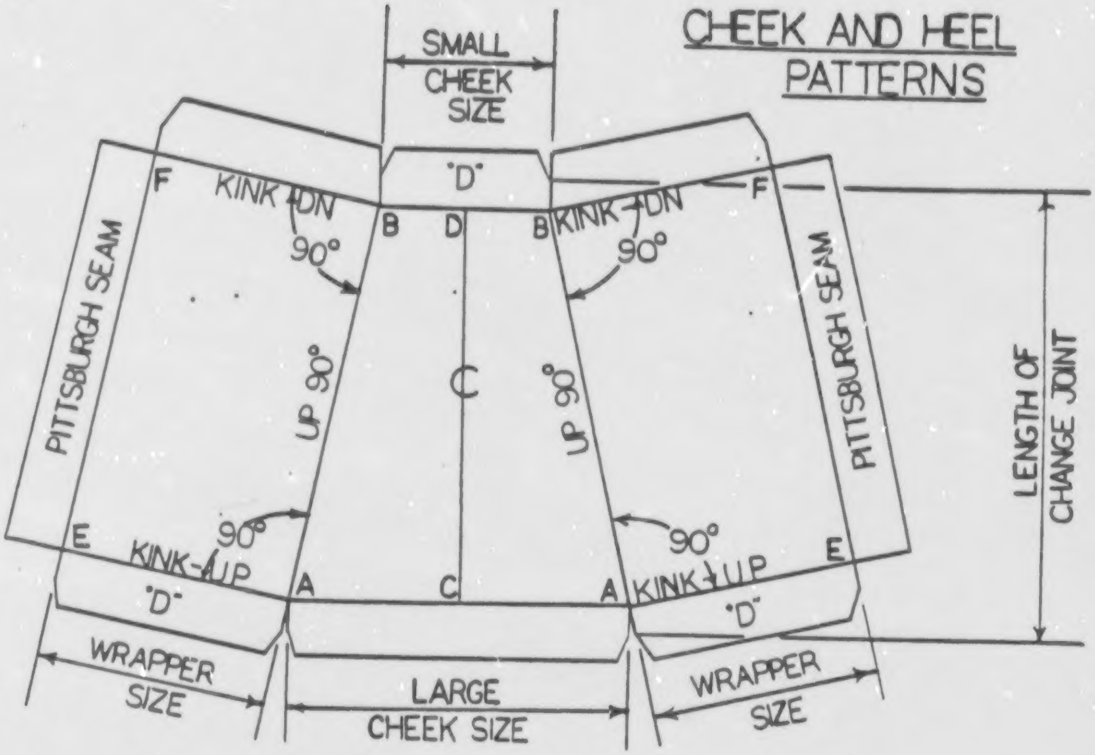
1.


SMALL
CHEEK SIZE
STR.
D
G
D
C
F
C
UP-90°
2
REQ.
UP-90°
LENGTH OF CHANGE JOINT
B
E
B
STR.
A
A
LARGE
CHEEK SIZE

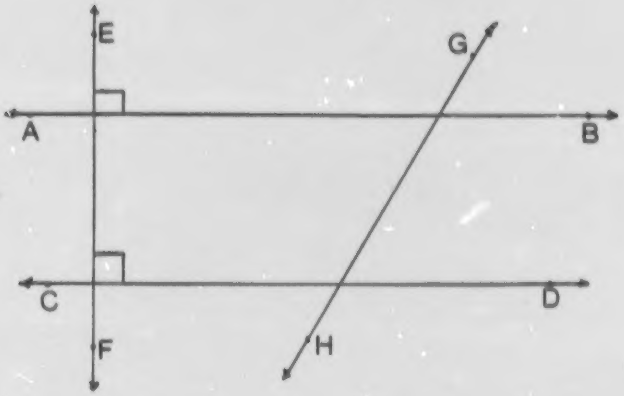
2.


T.D.
CHEEK SIZE
T.D.= TRUE THROAT DEPTH
CHEEK PATTERN
H
UP-90°
G
CHEEK SIZE
UP-90°
2-REQ.
1-RIGHT
1-LEFT
E
F
B
C
CHEEK SIZE
UP-90°
HEIGHT OF THROAT
A
UP-90°
D
1/2
1
T.D.

3.


SMALL CHEEK SIZE
CHEEK AND HEEL PATTERNS
"D"
F
KINK-DN
B
D
B
KINK-DN
F
90°
90°
PITTSBURGH SEAM
UP 90°
C
UP 90°
PITTSBURGH SEAM
LENGTH OF CHANGE JOINT
E
90°
KINK-UP
A
C
A
KINK-UP
90°
E
"D"
"D"
WRAPPER SIZE
LARGE CHEEK SIZE
WRAPPER SIZE

4.



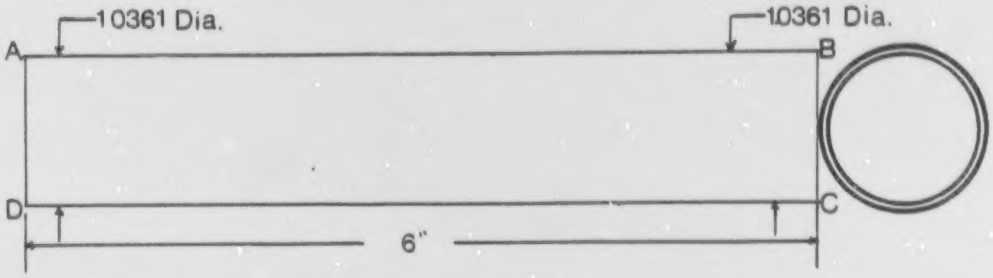
Using the above drawing, identify the following pairs of lines as parallel, perpendicular, or neither.

a) $\overline{EF}$ and $\overline{CD}$

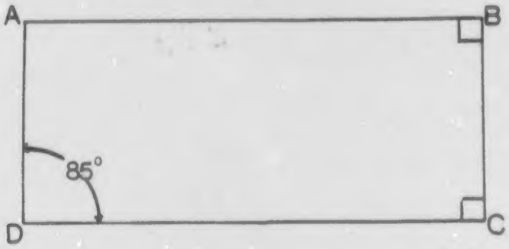
b) $\overline{EF}$ and $\overline{GH}$

c) $\overline{AB}$ and $\overline{CD}$

5. In the shaft illustrated below indicate two pairs of parallel lines.

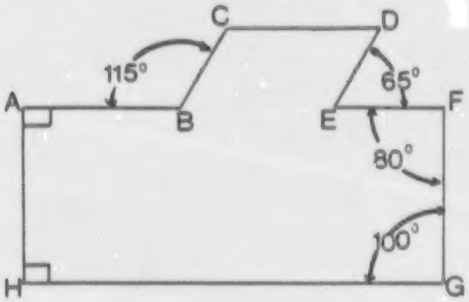

1.0361 Dia.
1.0361 Dia.
A
B
D
C
6"

6. In this sketch, which lines are parallel?



278

7. In the sketch below, identify the lines that are parallel to each other.



C
D
115°
65°
A
B
E
F
80°
100°
H
G

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# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

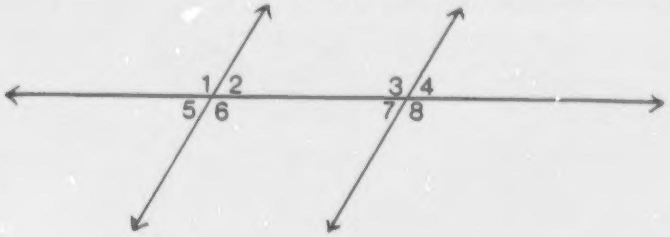
Tell relationships of angles formed by perpendicular and parallel lines.

## PERFORMANCE OBJECTIVE #57

Given a pair of parallel lines cut by a transversal and the measure of one angle which is formed, find the measures of the other seven angles.

## SAMPLE ITEM

Given: m∠1 = 140°
Find the measures of ∠'s 2-8. (Ans: m∠3 = m∠6 = m∠8 = 140
m∠2 = m∠4 = m∠5 = m∠7 = 40)

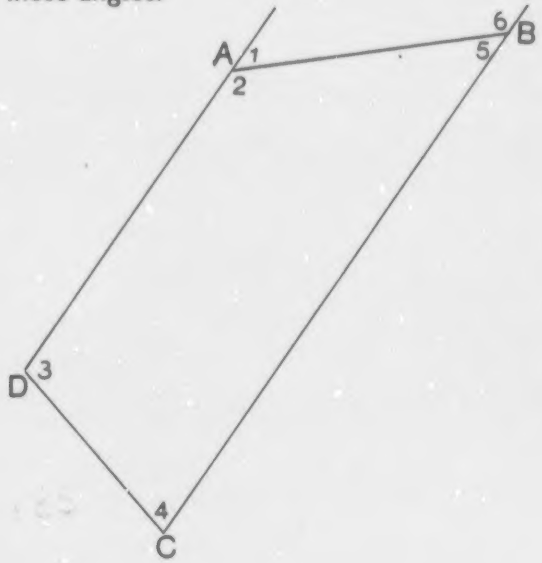


## EVALUATION

Given $\overline{AD} \parallel \overline{CB}$; m∠1 = 30°; m∠3 = 95°

Find the measures of these angles.

1. ∠ 2
2. ∠ 4
3. ∠ 5
4. ∠ 6



## ANSWERS TO EVALUATION

1. $150^\circ$
2. $85^\circ$
3. $30^\circ$
4. $150^\circ$

## ANSWERS TO APPLICATIONS

1. $\angle B = 145^\circ$
   $\angle C = 35^\circ$
   $\angle D = 145^\circ$
   $\angle E = 35^\circ$
   $\angle F = 145^\circ$
   $\angle G = 35^\circ$
   $\angle H = 145^\circ$

2. a) $\angle 2 = 135^\circ$
   $\angle 3 = 45^\circ$
   $\angle 4 = 45^\circ$
   $\angle 5 = 135^\circ$
   $\angle 6 = 45^\circ$
   $\angle 7 = 45^\circ$
   $\angle 8 = 135^\circ$

   b) $\angle 1 = 148^\circ$
   $\angle 2 = 148^\circ$
   $\angle 3 = 32^\circ$
   $\angle 5 = 148^\circ$
   $\angle 6 = 32^\circ$
   $\angle 7 = 32^\circ$
   $\angle 8 = 148^\circ$

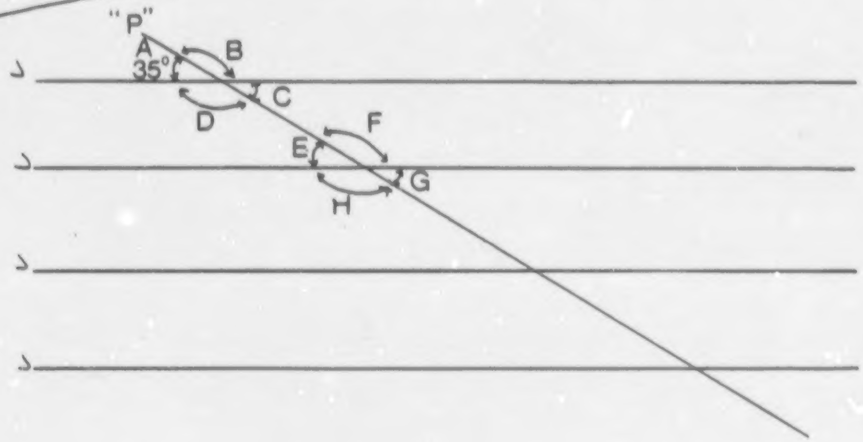
   c) $\angle 1 = 112^\circ\ 15'$
   $\angle 2 = 112^\circ\ 15'$
   $\angle 3 = 67^\circ\ 45'$
   $\angle 4 = 67^\circ\ 45'$
   $\angle 5 = 112^\circ\ 15'$
   $\angle 6 = 67^\circ\ 45'$
   $\angle 7 = 67^\circ\ 45'$

3. $\angle A = 132^\circ\ 40'$
   $\angle B = 47^\circ\ 20'$

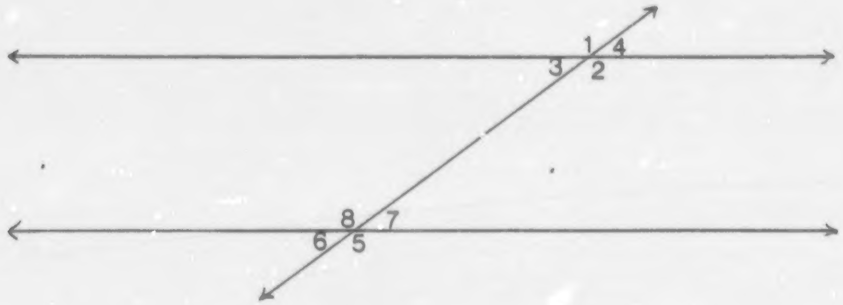
# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #57

Performance Objective #57: Given a pair of parallel lines cut by a transversal and the measure of one angle which is formed, find one measure of the other seven angles.

1. Refrigerant lines are to be installed over a ceiling that has bar joists. The pipe is labeled "P" and the joists are labeled "J." The angle "A" is 35°. What are the measures of the other seven angles?



2.

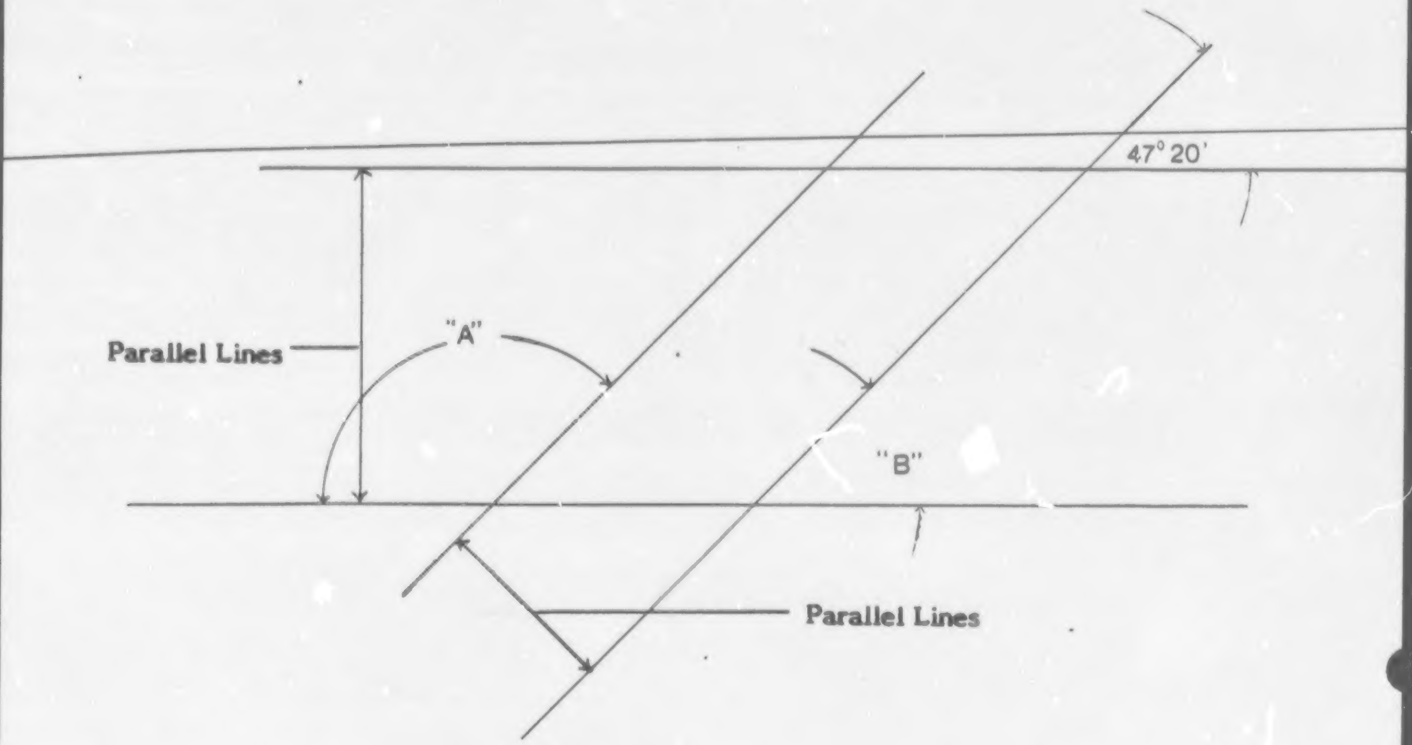


a) If the measure of angle 1 is 135°, find the measures of angles 2 through 8.

b) If the measure of angle 4 is 32°, find the measures of the other angles.

c) If the measure of angle 8 is 112° 15', find the measures of angles 1 through 7.

3. In the illustration below, the machinist must find the angles "A" and "B" and give their measurement in degrees and minutes.


47° 20'
Parallel Lines
"A"
"B"
Parallel Lines

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

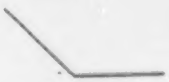
Classify angles according to their measures.

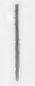
## PERFORMANCE OBJECTIVE #58

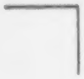
Given an angle (drawing or measure), classify it as acute, obtuse, straight or right.

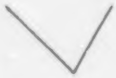
## SAMPLE ITEM

Identify each of the following angles as acute, obtuse, straight or right.

a) 

b) 

c) 

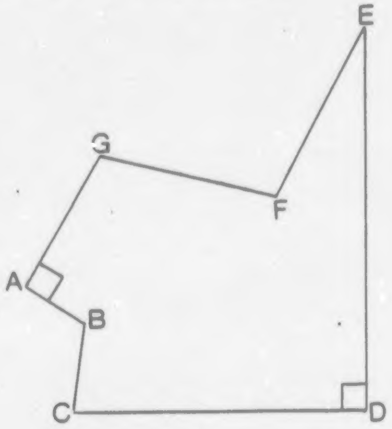
d) 

(Ans: a) obtuse, b) straight, c) right, d) acute)

## EVALUATION

Identify each angle as acute, obtuse, right, or straight.

1. ∠ A
2. ∠ C
3. ∠ E
4. ∠ G



## ANSWERS TO EVALUATION

1. right
2. acute
3. acute
4. obtuse

## ANSWERS TO APPLICATIONS

1. a) right
   b) obtuse
   c) acute
   d) obtuse
   e) right
   f) right
   g) straight
   h) acute
2. a) acute
   b) obtuse
   c) straight
   d) right
3. a) acute
   b) acute
   c) right
   d) obtuse
   e) straight
   f) straight
   g) right
   h) acute

i) obtuse

j) obtuse

k) acute

l) right

m) acute

n) right

o) obtuse

p) obtuse

q) straight

# APPLICATIONS FOR PERFORMANCE OBJECTIVE #58

Performance Objective #58: Given an angle (drawing or measure), classify it as acute, obtuse, straight or right.

1. From the following drawing, classify the identified angles as acute, obtuse, straight or right.

    a) ∠ FGD

    b) ∠ EDA

    c) ∠ DAB

    d) ∠ ABE

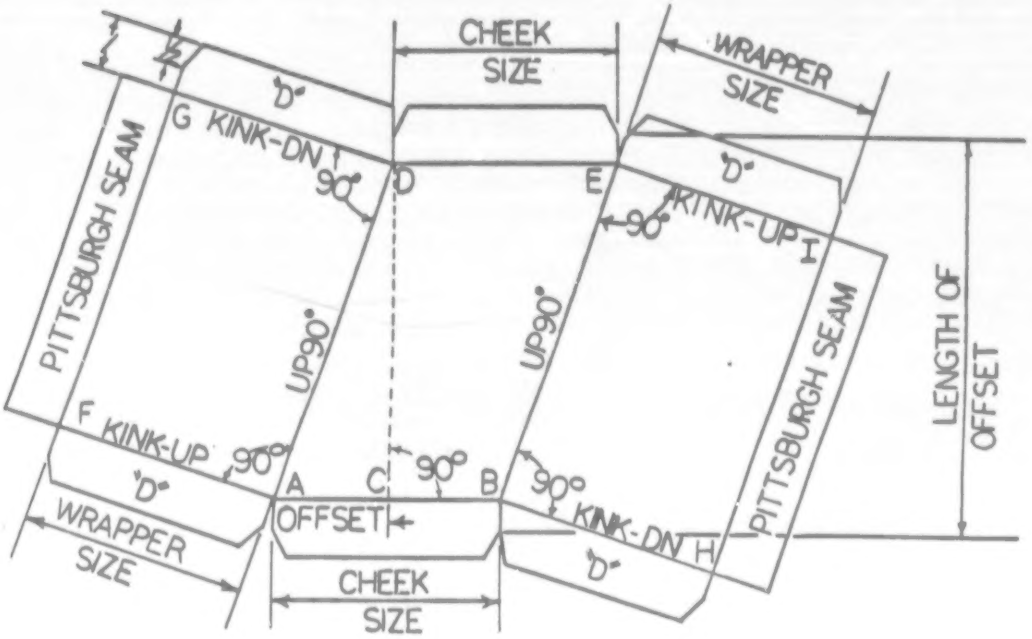
    e) ∠ EBH

    f) ∠ BEI

    g) ∠ ACB

    h) ∠ BED

CHEEK AND HEEL PATTERNS


CHEEK
SIZE
WRAPPER
SIZE
"D"
G KINK-DN
90°
D
E
"D"
90°
KINK-UP
I
PITTSBURGH SEAM
UP90°
UP90°
PITTSBURGH SEAM
LENGTH OF
OFFSET
F KINK-UP
90°
A
C
90°
B
90°
KINK-DN
H
"D"
OFFSET
"D"
WRAPPER
SIZE
CHEEK
SIZE

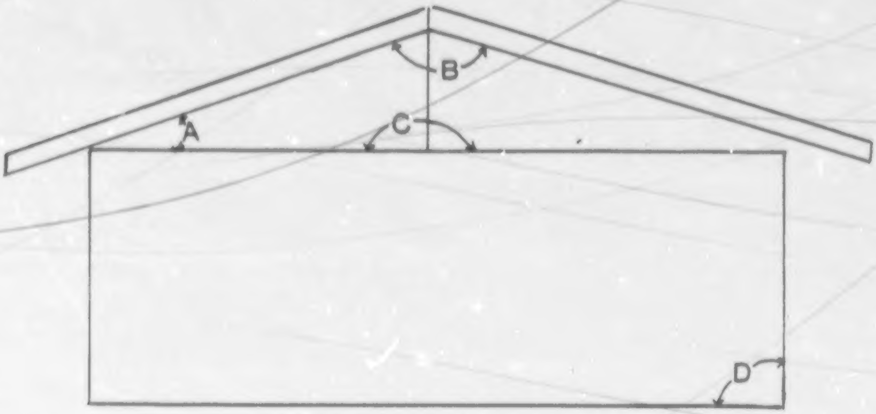
2. Classify angles A, B, C and D as acute, obtuse, straight or right.

a) ∠ A

b) ∠ B

c) ∠ C

d) ∠ D



3. Classify each of the following angles as obtuse, acute, straight or right.

a) 27°

b) 49°

c) 90°

d) 136°

e) 180°

f) 360°

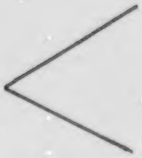
g) 270°

h) 15°

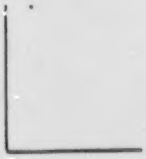
i) 91.6°

j) 102°

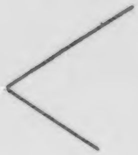
k)



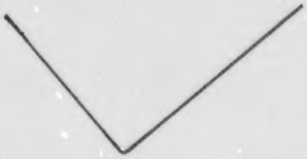
l)



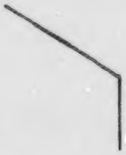
m)



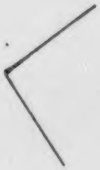
n)



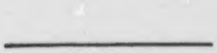
o)



p)



q)



# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Identify angle pairs and state relationships regarding angle measures.

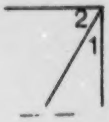
## PERFORMANCE OBJECTIVE #59

Given drawings of supplementary, complementary, vertical and adjacent angles, identify each pair of angles.

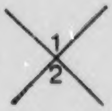
## SAMPLE ITEM

Identify each pair of angles as supplementary, complementary, vertical or adjacent.

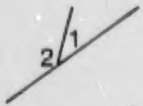
a)



b)



c)

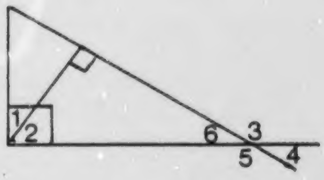


(ans: a) complementary adjacent; b) vertical; c) supplementary adjacent)

## EVALUATION

Identify each pair of angles as vertical, adjacent, supplementary or complementary.

1. ∠ 1 and 2
2. ∠ 6 and 3
3. ∠ 6 and 4
4. ∠ 3 and 5



## ANSWERS TO EVALUATION

1. complementary and adjacent
2. adjacent and supplementary
3. vertical
4. vertical

## ANSWERS TO APPLICATIONS

1. a) $\angle EOB$ and $\angle AOF$
   b) $\angle AOF$ and $\angle EOB$
   c) $\angle EOB$
2. a) vertical
   b) adjacent and supplementary
   c) adjacent and complementary
3. a) Complementary (equaling 90°)
   b) Supplementary (equaling 180°)
   c) Vertical (Since $\overleftrightarrow{AD}$ and $\overleftrightarrow{BC}$ intersect at 0, $\angle AOB$ and $\angle COD$ are vertical angles and are congruent.)

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #59

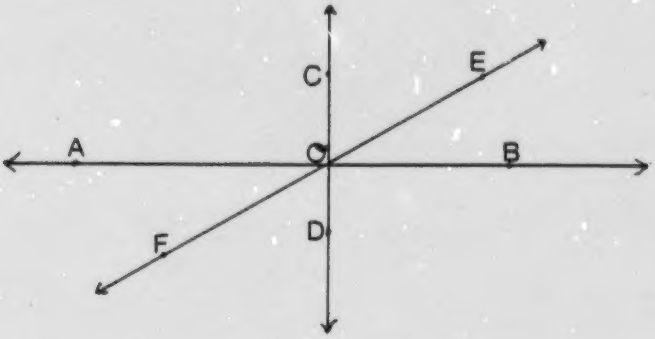
Performance Objective #59: Given drawings of supplementary, complementary, vertical and adjacent angles, identify each pair of angles.

1. Given that $\overleftrightarrow{AB}$ is perpendicular to $\overleftrightarrow{CD}$, complete:

   a) ∠ AOE is supplementary to ∠ ____ and ∠ ____.

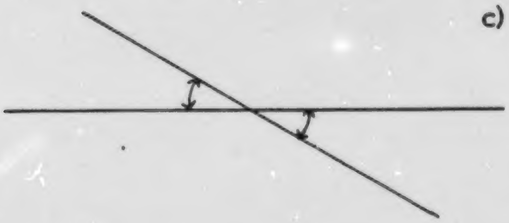
   b) ∠ DOF is complementary to ∠ ____ and ∠ ____.

   c) ∠AOF and ________ are vertical angles.

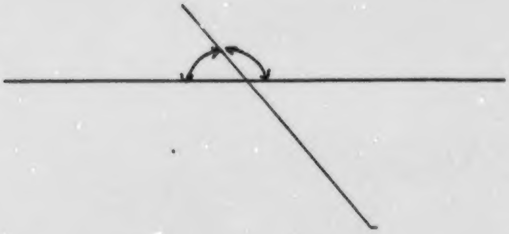


2. Identify each of the following sets of angles as supplementary, complementary, vertical and adjacent angles.

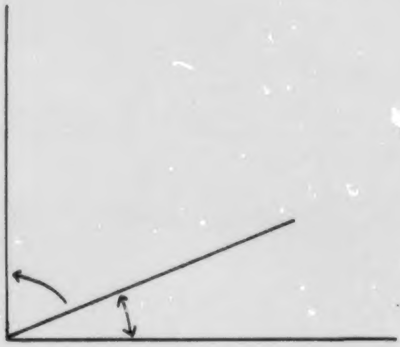
a)



b)

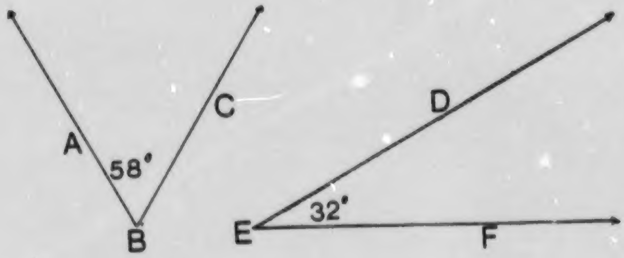


c)

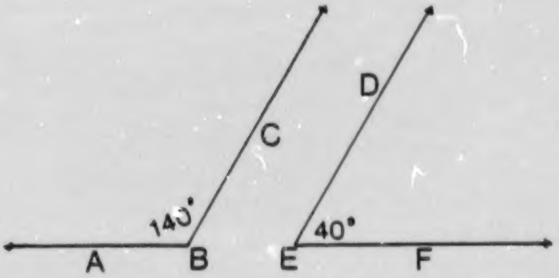


3. Identify each pair of angles as supplementary, complementary, vertical or adjacent. Explain.

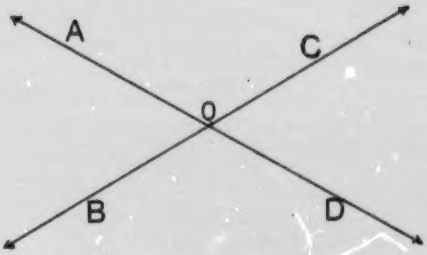
a)


A
58°
C
B
D
32°
E
F

b)


C
D
140°
40°
A
B
E
F

c)



# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Identify angle pairs and state relationships regarding angle measures.

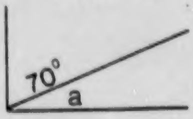
## PERFORMANCE OBJECTIVE #60

Given the measure of one angle in a pair of supplementary, complementary or vertical angles, find the measure of the other angle.

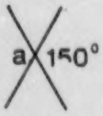
## SAMPLE ITEM

Find the measure of ∠a in each drawing.

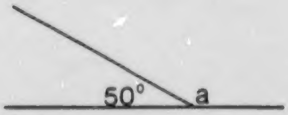
a)



b)



c)



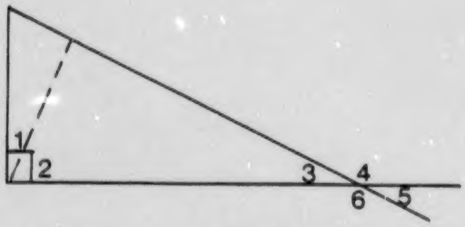
(ans: a) 20; b) 150; c) 130)

## EVALUATION

Given: m∠1 = 35°
m∠3 = 40°

Find:

1. m∠2
2. m∠4
3. m∠5
4. m∠6



## ANSWERS TO EVALUATION

1. 55°
2. 140°
3. 40°
4. 140°

## ANSWERS TO APPLICATIONS

1. ∠ A = 35° 30'
   ∠ B = 39° 45'
2. 64° 39'
3. 67° 11' 30"
4. a) 98°
   b) 22°
   c) 33°
5. a) ∠ DEF = 115°
   b) ∠ DEF = 23°
   c) ∠ COD = 35°

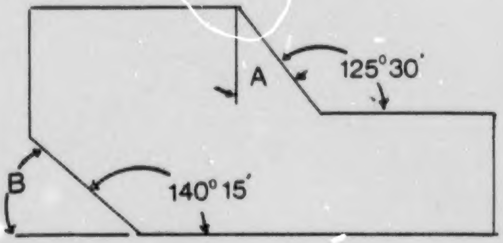
# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #60

Performance Objective #60: Given the measure of one angle in a pair of supplementary, complementary or vertical angles, find the measure of the other angle.

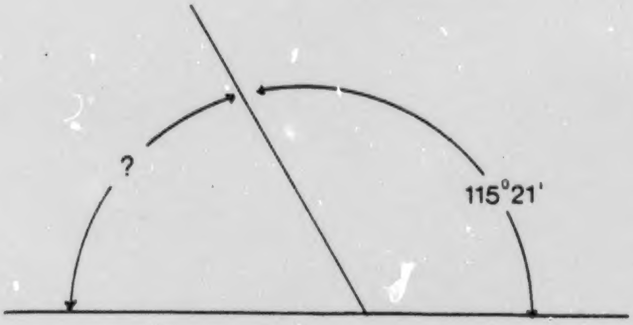
1. The machinist assigned to make this die insert must find angles A and B to set up the machine to produce the angles required.

∠A = ____________

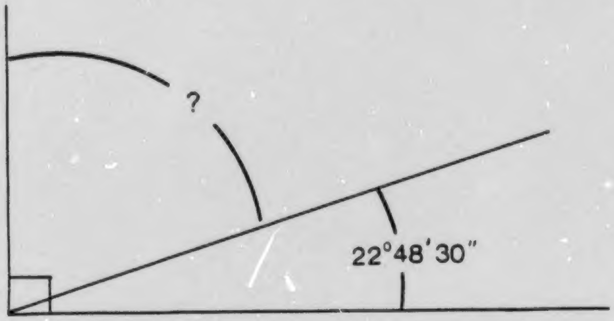
∠B = ____________



2. The machinist must be able to find the supplementary angle.



3. The machinist must be able to find the complementary angle.

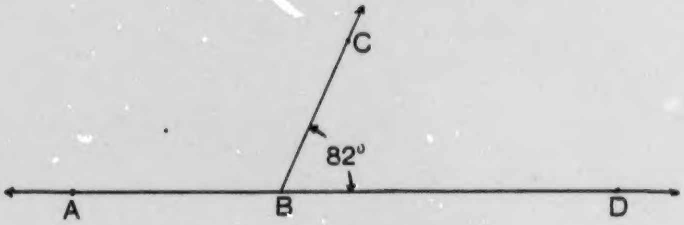


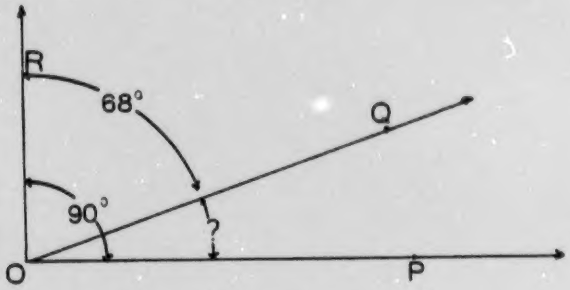
4. Without using a protractor, find the measure of:

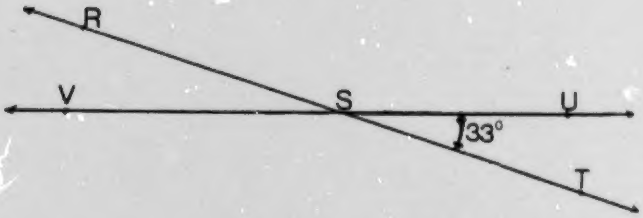
a) ∠ ABC

b) ∠ POQ

c) ∠ RSV

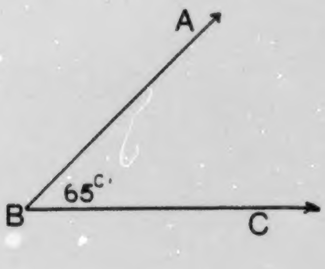


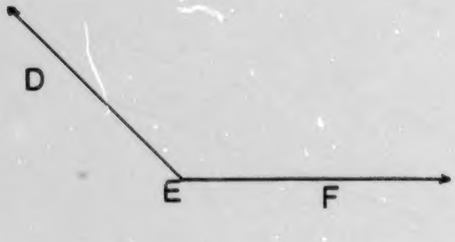




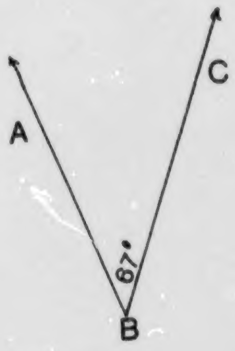
5. Give the missing measurement in the pairs of angles below.

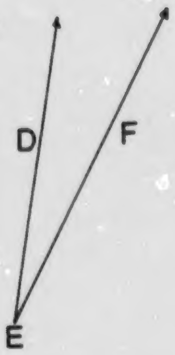
a. Supplementary ∠



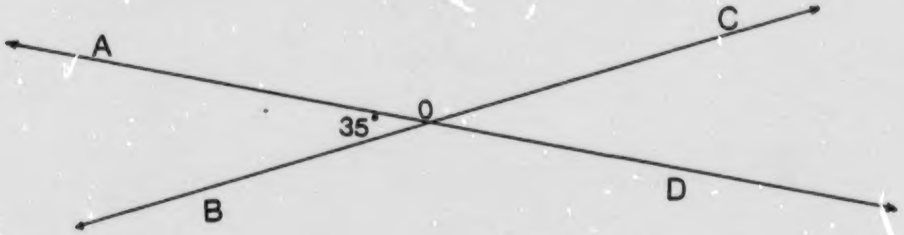


b. Complementary ∠





c. Vertical ∠



# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Measure angles.

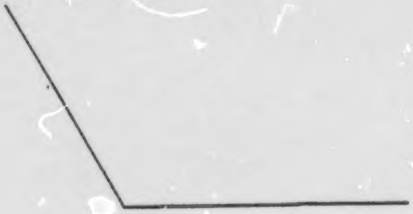
## PERFORMANCE OBJECTIVE #61

Given an angle and a protractor, find the measure of the angle to the nearest half-degree.

## SAMPLE ITEM

Measure this angle:

(Ans: 120°)



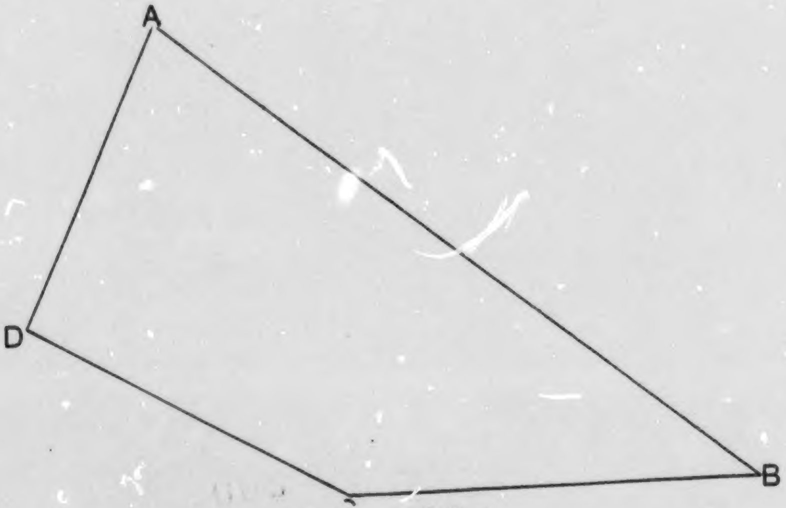
## NOTES

**General:** If students are reminded to note whether one angle is acute or obtuse, they will have less difficulty reading the protractor. Estimating angle measure is an important skill also.

**Trade and Industry:** In trade and industry an employee will often need to find the measurement of angles. In the machine trade a person must know the angles between the threads of bolts and screws. In woodworking a person must know the angles of mitre cuts and joints. In building construction angular measurements are used in laying off the various cuts in roof framing.

## EVALUATION

Measure ∠'s A, B, C, and D.



## ANSWERS TO EVALUATION

1. A = 75°
2. B = 40°
3. C = 150°
4. D = 95°

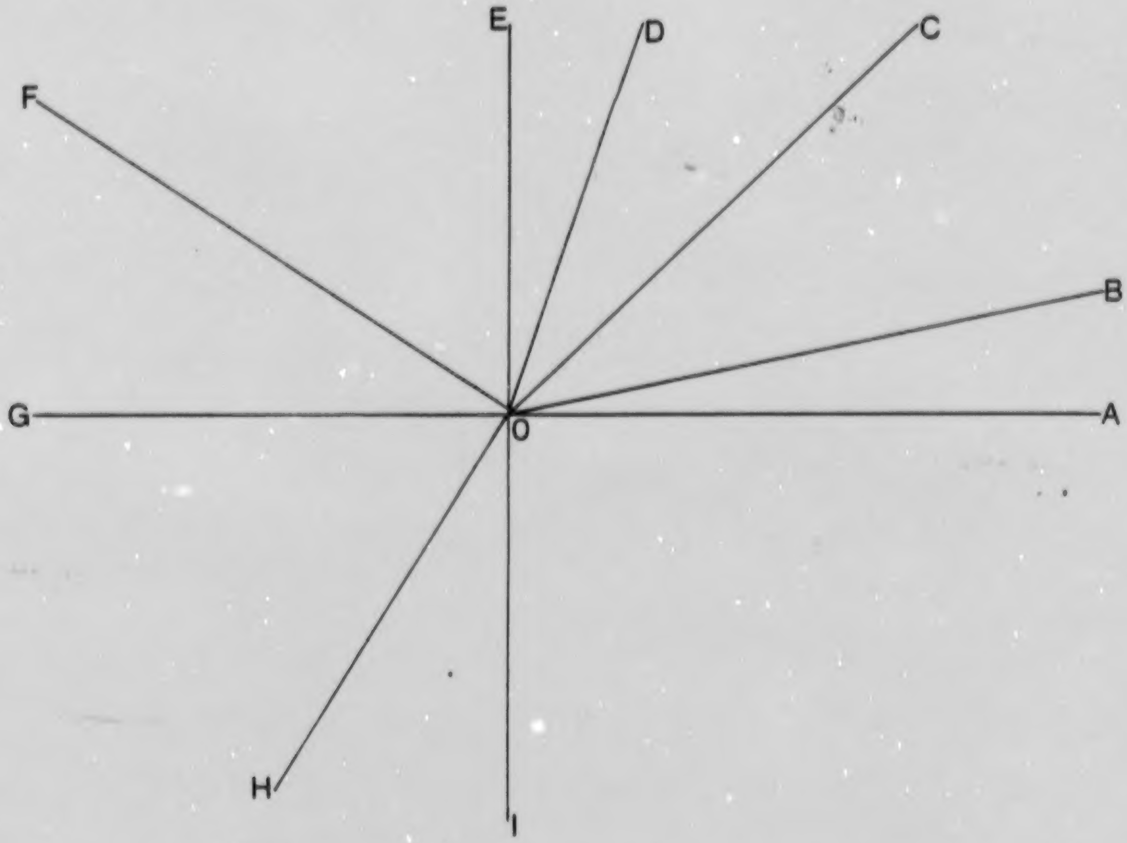
## ANSWERS TO APPLICATIONS

1. 9°
2. 34°
3. 29°
4. 18°
5. 54°
6. [illegible]°
7. 57°
8. 33°
9. 90°
10. 90°
11. 102°
12. 136°
13. 93°
14. 138°
15. 132°
16. 90°
17. 42°
18. 162°
19. 165°
20. 99°

Note: Answers may vary due to measuring instruments or alterations occurring during printing.

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #61

Performance Objective #61: Given an angle and a protractor, find the measure of the angle to the nearest half-degree.
Using the diagram below, measure each of the angles listed.



1. $\angle$ AOB =

2. $\angle$ BOC =

3. $\angle$ COD =

4. $\angle$ DOE =

5. $\angle$ EOF =

6. $\angle$ FOG =

7. $\angle$ GOH =

8. $\angle$ HOI =

9. $\angle$ IOA =

10. $\angle$ AOE =

11. $\angle$ FOC =

12. $\angle$ FOB =

13. $\angle$ FOH =

14. $\angle$ GOC =

15. $\angle$ COI =

16. $\angle$ EOG =

17. $\angle$ AOC =

18. $\angle$ DOI =

19. $\angle$ HOD =

20. $\angle$ BOI =

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Draw angles.

## PERFORMANCE OBJECTIVE #62

Given a protractor, draw an angle of given measure correct to the nearest half-degree.

## SAMPLE ITEM

Draw an angle with a measure of 45°.

## EVALUATION

Draw angles with these measures. Use a protractor.

1. 80°
2. 132°
3. 61°
4. 155°

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #62

Performance Objective #62: Given a protractor, draw an angle of given measure correct to the nearest half-degree.

1. 35°

2. 59°

3. 132°

4. $51\frac{1}{2}°$

5. 65°

6. 135°

7. 180°

## COMPETENCY

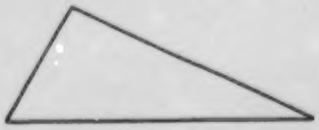
Classify triangles according to the length of their sides and the measure of their angles.

## PERFORMANCE OBJECTIVE #63

Given a triangle, classify it as acute, obtuse, right, scalene, isosceles, or equilateral.

## SAMPLE ITEM

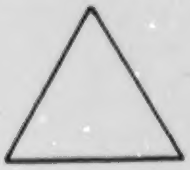
Classify this triangle according to its sides and angles.
(ans: scalene, obtuse)



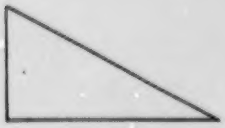
## EVALUATION

Classify each triangle according to its sides and angles.

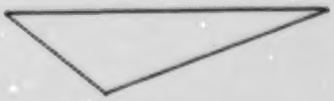
1.



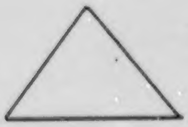
2.



3.



4.



## ANSWERS TO EVALUATION

1. equilateral, equiangular
2. scalene, right
3. scalene, obtuse
4. isosceles, acute

## ANSWERS TO APPLICATIONS

1. a) acute
   b) equilateral

2. a) obtuse
   b) scalene

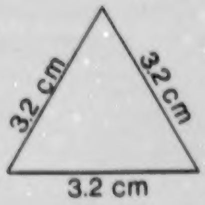
3. a) right
   b) scalene

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #63

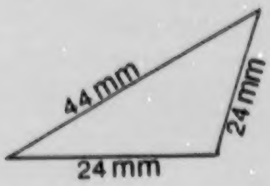
Performance Objective #63: Given a triangle, classify it as acute, obtuse or right and scalene, isosceles or equilateral.

Classify each triangle as:
- a) acute, obtuse or right
- b) scalene, equilateral or isosceles

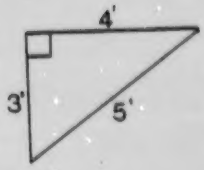
1.


3.2 cm
3.2 cm
3.2 cm

2.


44 mm
24 mm
24 mm

3.



## COMPETENCY

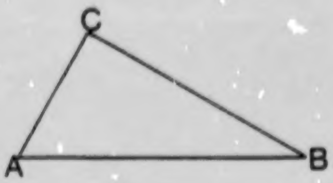
Identify the parts of triangles.

## PERFORMANCE OBJECTIVE #64

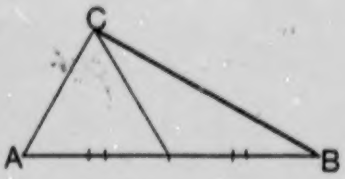
Given a triangle, locate the medians, altitudes, and angle bisectors.

## SAMPLE ITEM

Draw the median to side AB of the triangle.



ans.)



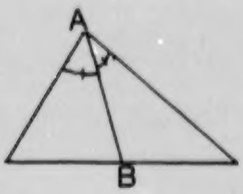
## NOTES

Students must understand bisect and midpoint to identify and draw medians and angle bisectors. Be sure students have the opportunity to work with many different shapes of triangles. Students should be able to draw these parts using a protractor and ruler. Construction with a compass and straight edge is also desirable.

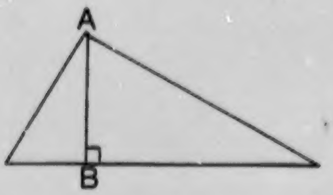
## EVALUATION

Identify segment AB in each triangle:

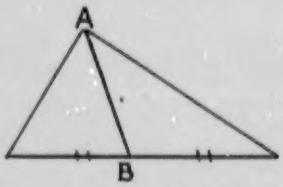
1.



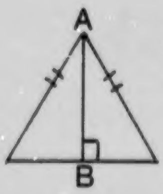
2.



3.



4.



## ANSWERS TO EVALUATION

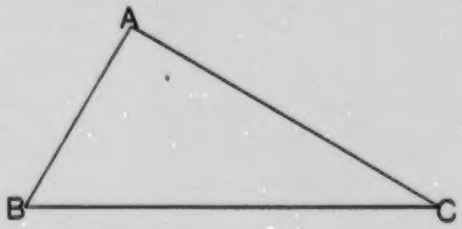
1. angle bisector
2. altitude
3. median
4. angle bisector, altitude and median

# APPLICATIONS FOR PERFORMANCE OBJECTIVE #64

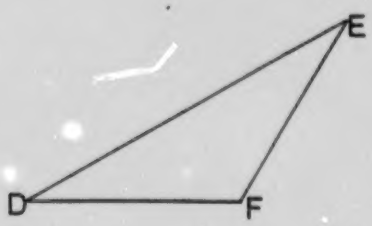
Performance Objective #64: Given a triangle, locate the medians, altitudes and angle bisectors.

Draw or construct:

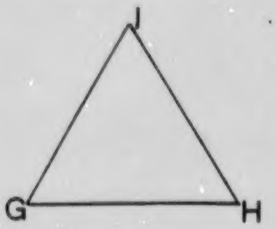
1. the median of $\triangle$ ABC



2. the altitudes of $\triangle$ DEF



3. the angle bisectors of $\triangle$ GHI



# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

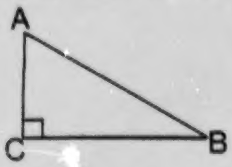
Identify the parts of triangles.

## PERFORMANCE OBJECTIVE #65

Given a right triangle, identify the legs and hypotenuse.

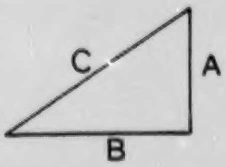
## SAMPLE ITEMS

Identify each side in this right triangle as a leg or hypotenuse.



(ans: $\overline{AB}$ is hypotenuse; $\overline{AC}$ and $\overline{CB}$ are legs)

Identify each side in this right triangle as a hypotenuse, altitude leg, and base leg.



(ans: C is hypotenuse; A is altitude leg; B is base leg)

## NOTES

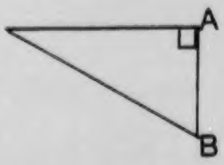
**General:** For students having difficulty with "the side opposite" provide some type of manipulative which they can use to make triangles and then pick up sides.

**Building Construction:** In building construction the lengths of common rafters in the roof frame are determined by using a table on the rafter square. This table is derived from the Rule of Pythagoras, or the right triangle rule as it is commonly known.

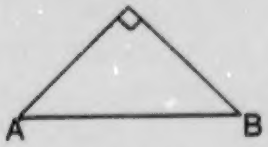
## EVALUATION

Identify side $\overline{AB}$ in each right triangle as a leg or hypotenuse.

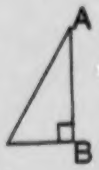
1.



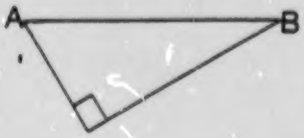
2.



3.



4.



## ANSWERS TO EVALUATION

1. leg
2. hypotenuse
3. leg
4. hypotenuse

## ANSWERS TO APPLICATIONS

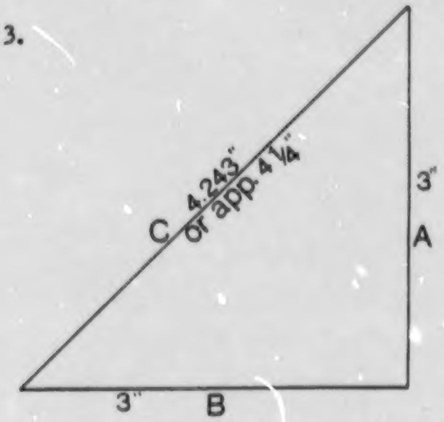
1. a) hyp: $\overline{AB}$
   legs: $\overline{AC}$ and $\overline{BC}$

   b) hyp: $\overline{EH}$
   legs: $\overline{EF}$ and $\overline{FH}$

   c) hyp: $\overline{HI}$
   legs: $\overline{GH}$ and $\overline{GI}$

2. a) leg
   b) hypotenuse
   c) leg

3.



$$\overset{a^2}{(3 \times 3)} + \overset{b^2}{(3 \times 3)} = \overset{c^2}{18}$$

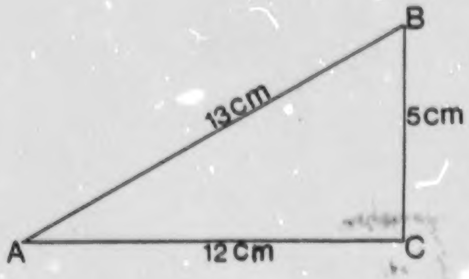
$$\sqrt{18} = 4.243''$$

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE 65

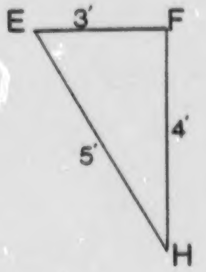
Performance Objective #65: Given a right triangle, identify the legs and hypotenuse.

1. Verify that each triangle is a right triangle. Identify each side as either the hypotenuse or a leg.

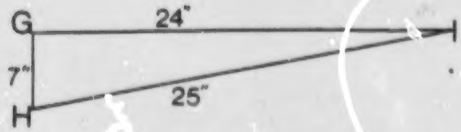
a)


B
13cm
5cm
A
12 cm
C

b)



c)

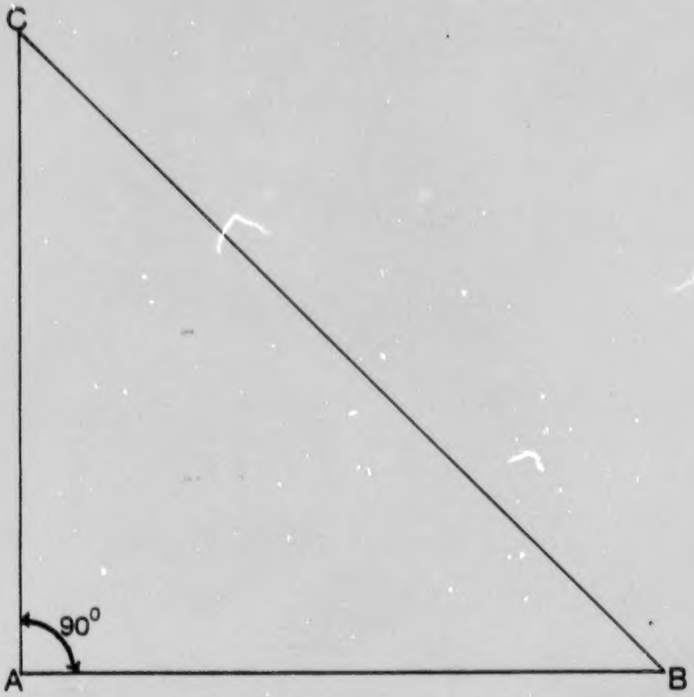


2. Identify by naming each of the following line segments.

   a) $\overline{AB}$

   b) $\overline{BC}$

   c) $\overline{CA}$



3. Draw a right triangle with one leg, A, 3" long; a second leg, B, 3" long, intersecting leg A at 90°. Connect the ends of line segment (leg) A and line segment (leg) B to form the hypotenuse C. What is the length of the hypotenuse? Prove your answer.

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

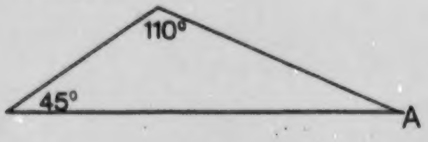
Find missing angle of a triangle.

## PERFORMANCE OBJECTIVE #66

Given the measure of two angles of a triangle, find the measure of the third angle.

## SAMPLE ITEM

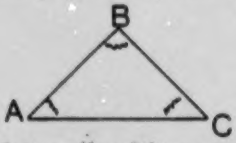
Find the measure of angle A.

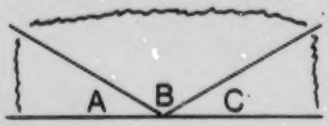


(ans: 25°)

## NOTES

Have students measure the angles of several triangles and add the measures so that they see that the sum is 100°. Another activity is to give the students triangles cut from paper and have them tear the three angles off and form a straight angle.



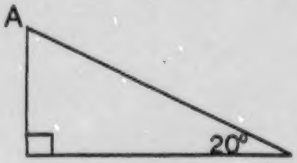


This activity works well with waxed paper on the overhead projector. Students should know that the acute angles of a right triangle are complementary and that the base angles of isosceles triangles are congruent.

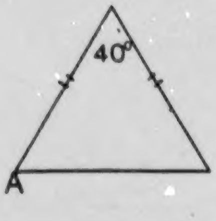
## EVALUATION

Find the measure of angle A in each triangle.

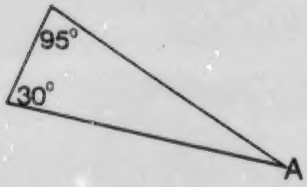
1.



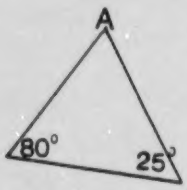
2.



3.



4.



## ANSWERS TO EVALUATION

1. 70°
2. 70°
3. 55°
4. 75°

## ANSWERS TO APPLICATIONS

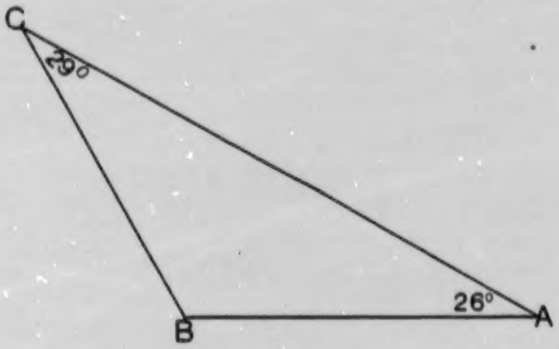
1. 125°
2. 55°
3. 89° 30'
4. 77.9°
5. 80°

## APPLICATIONS
## FOR
## PERFORMANCE OBJECTIVE #66

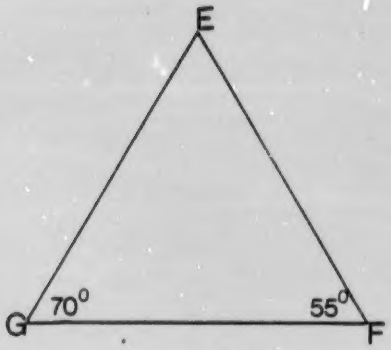
Performance Objective #66: Given the measures of two angles of a triangle, find the measure of the third angle.

Find the measure of:

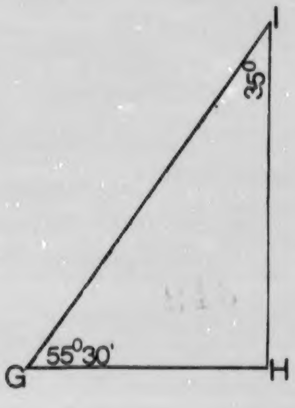
1. ∠ B



2. ∠ E



3. ∠ H



4. What is the third angle of a triangle having 45.8 degrees and 56.3 degrees for the two known angles?

5. If you know that a triangle has two angles measuring 50 degrees each, what does the third angle measure?

## COMPETENCY

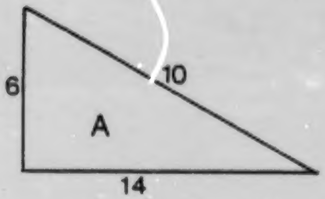
Identify similar triangles and find the missing side.

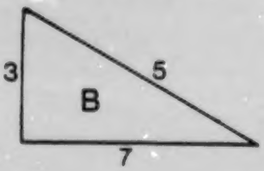
## PERFORMANCE OBJECTIVE #67

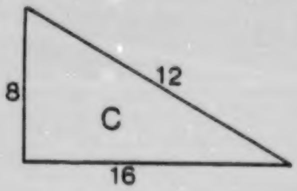
Given two triangles, tell whether or not they are similar.

## SAMPLE ITEM

Which two triangles are similar?





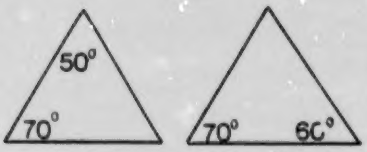


(ans: A and B)

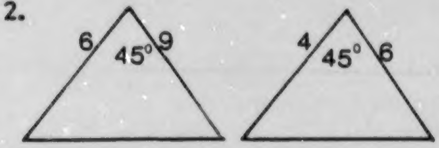
## EVALUATION

Tell whether or not each pair of triangles is similar.

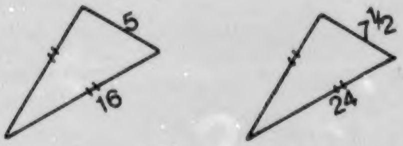
1.



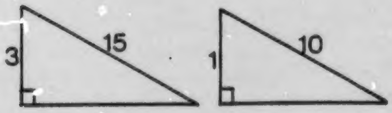
2.



3.



4.



## ANSWERS TO EVALUATION

1. yes
2. yes
3. yes
4. no

## ANSWERS TO APPLICATIONS

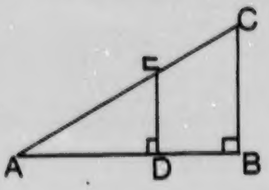
1. yes
2. yes
3. yes
4. yes
5. no
6. yes

### APPLICATIONS
### FOR
### PERFORMANCE OBJECTIVE #67

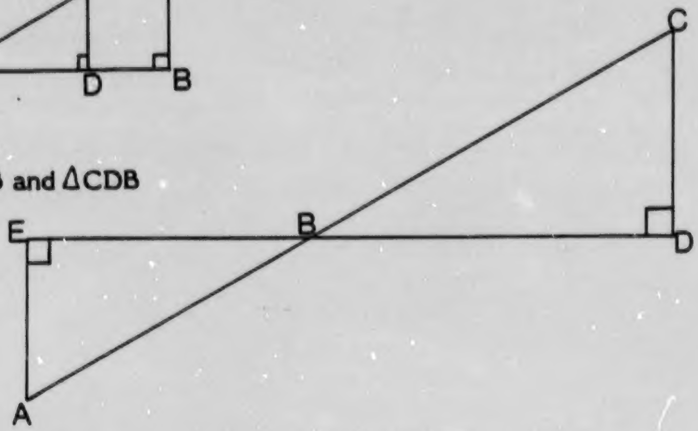
Performance Objective #67: Given two triangles, tell whether or not they are similar.

State whether or not each pair of triangles is similar.

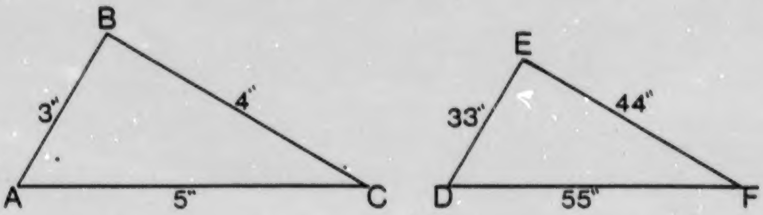
1. Δ ABC and ΔADE



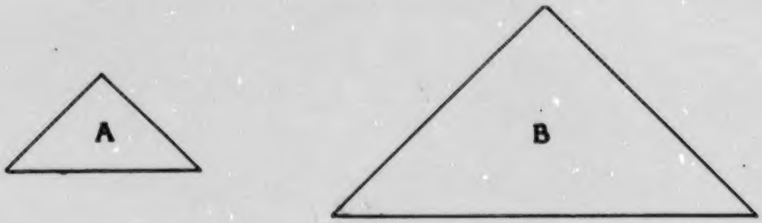
2. Δ AEB and ΔCDB



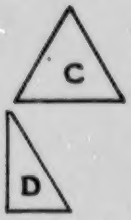
3. Δ ABC and Δ DEF


B
3"
4"
A
5"
C
E
33"
44"
D
55"
F

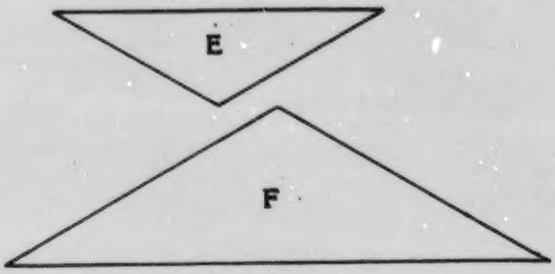
4. Δ A and Δ B



5. △ C and△ D



6. △ E and△ F



# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

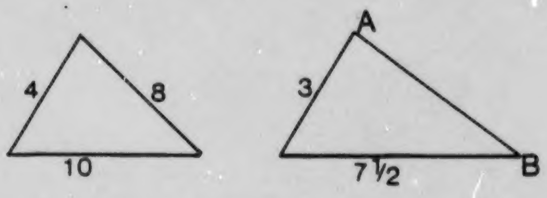
Identify similar triangles and find the missing side.

## PERFORMANCE OBJECTIVE #68

Given two similar triangles and the ratio of the lengths of the sides, find the length of the missing side.

## SAMPLE ITEM

Find side AB.

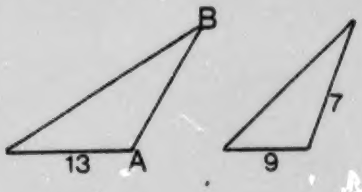

4
8
10
A
3
7 1/2
B

(ans: AB = 6)

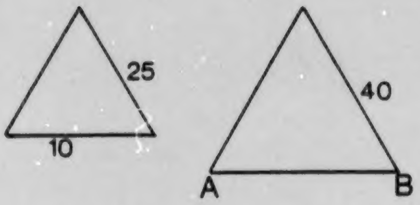
## EVALUATION

In each pair of similar triangles, find side AB.

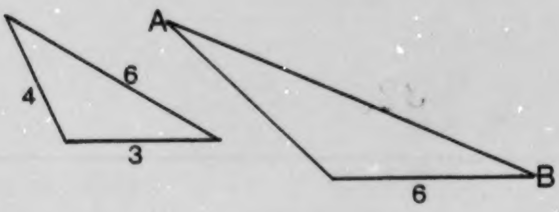
1.



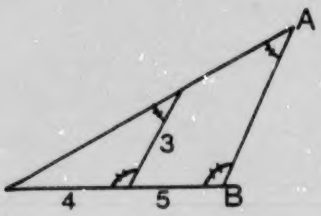
2.



3.



4.



## ANSWERS TO EVALUATION

1. $10\frac{1}{9}$
2. 16
3. 12
4. $6\frac{3}{4}$

## ANSWERS TO APPLICATIONS

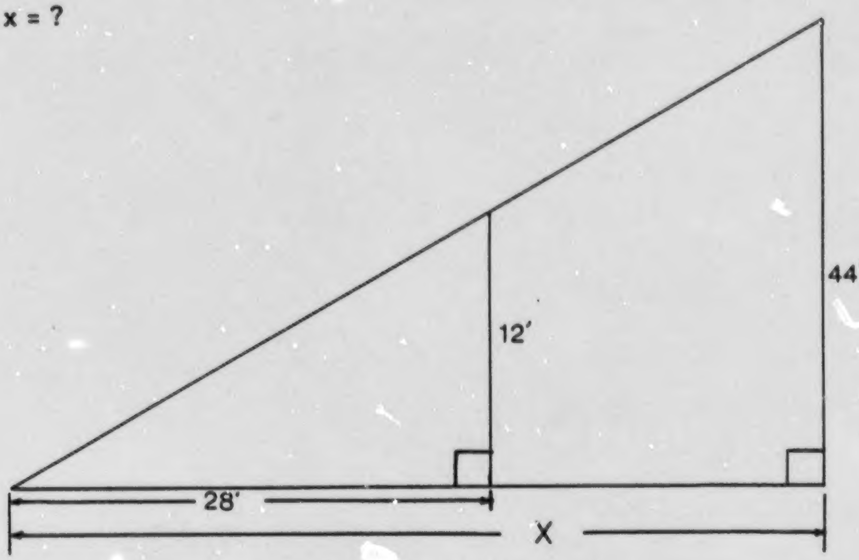
1. $102\frac{2}{3}$
2. 48.45 m
3. 67.7 m

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #68

Performance Objective #68: Given two similar triangles and the ratio of the length of the sides, find the length of the missing side.

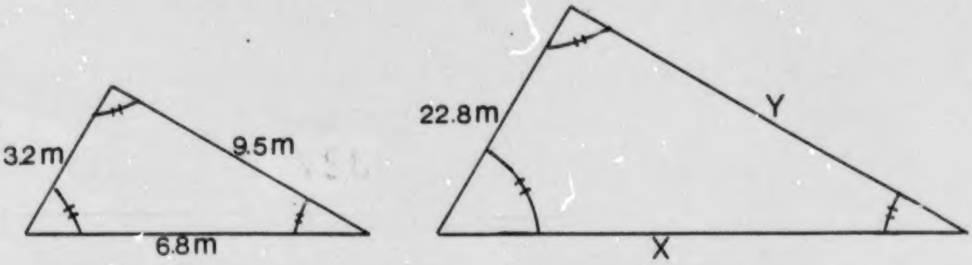
Given the following pairs of similar triangles, find the length of either x or y.

1. x = ?



2. x = ?

3. y = ?



# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

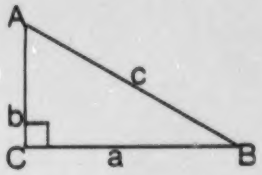
Use sine, cosine and tangent functions.

## PERFORMANCE OBJECTIVE #69

Given a right triangle, write the sine, cosine and tangent ratios.

## SAMPLE ITEM

Write the ratio for the sine of angle B.



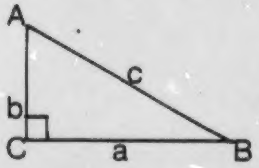
(ans: $\frac{b}{c}$)

## NOTES

Be sure students understand opposite and adjacent sides before beginning work with trigonometric ratios.

## EVALUATION

Using this right triangle, write these ratios.



1. tan ∠A
2. cos ∠B
3. sin ∠B
4. cos ∠A

## ANSWERS TO EVALUATION

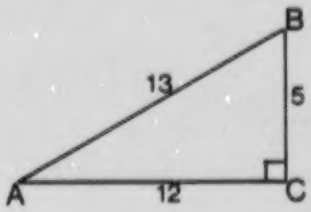
1. $\frac{a}{b}$
2. $\frac{a}{c}$
3. $\frac{b}{c}$
4. $\frac{b}{c}$

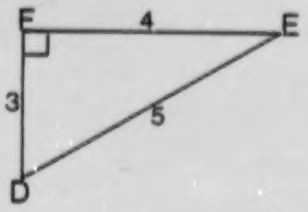
## ANSWERS TO APPLICATIONS

1. $\frac{5}{13}$
2. $\frac{12}{13}$
3. $\frac{12}{5}$
4. $\frac{3}{5}$
5. $\frac{3}{5}$
6. $\frac{3}{4}$
7. $\frac{5}{13}$
8. $\frac{12}{13}$

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #69

Performance Objective #69: Given a right triangle, write the sine, cosine and tangent ratios.





Using the above triangle, write these ratios.

1. sin∠A = ______
2. cos∠A = ______
3. tan∠B = ______
4. cos∠D = ______
5. sin∠E = ______
6. tan∠E = ______
7. cos∠B = ______
8. sin∠B = ______

## APPLIED VOCATIONAL MATHEMATICS

### COMPETENCY

Read trigonometric tables.

### PERFORMANCE OBJECTIVE #70

Given a table of trigonometric values, answer questions pertaining to the table.

### SAMPLE ITEM

Use a trig table to find the sine of an angle of 71° 20'. (See trig tables in Objective No. 51.)
(ans: 0.9474)

### NOTES

Take time with your students to see the nature of the trig tables. As angles get larger, notice what happens to the sine, cosine and tangent ratios. Note the relationship between sine and cosine of complementary angles. Stress reading tables at this time and not interpolation.

### EVALUATION

1. As angle measures increase, does the sine ratio increase or decrease?
2. Find these values from a trig table.
   a) sine 31°
   b) cos 42° 10'
   c) tan 45°

## ANSWERS TO EVALUATION

1. increase
2. a) 0.51504
   b) 0.74118
   c) 1.000

## ANSWERS TO APPLICATIONS

1. .5373
2. .9520
3. .5348
4. 34.37
5. 37° 50'
6. 77° 40'

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

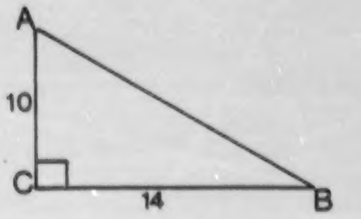
Use sine, cosine and tangent functions.

## PERFORMANCE OBJECTIVE #71

Given right triangles, use the sine, cosine and tangent functions to find missing sides and angles.

## SAMPLE ITEM

Find the measure of angle B.

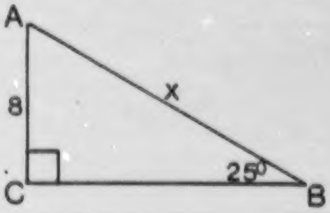


(ans: 35.5°)

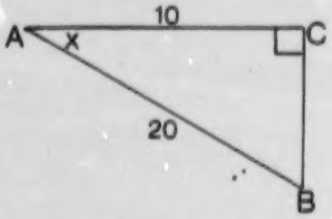
## EVALUATION

Find the indicated side or angle.

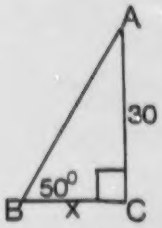
1.



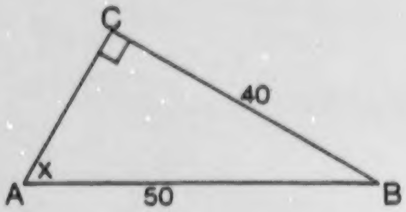
2.



3.



4.



## ANSWERS TO EVALUATION

1. 18.9
2. 60°
3. 25.2
4. 53.1°

## ANSWERS TO APPLICATIONS

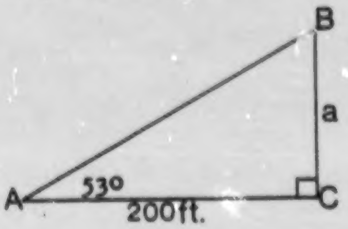
1. 265.4 ft.
2. 9 ft.
3. 20°
4. 19° 34'
5. 4.720"
6. 19° 35'

333

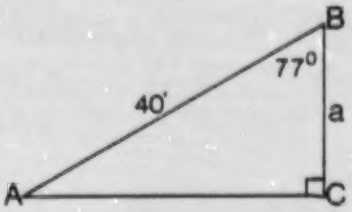
# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #71

Performance Objective #71: Given right triangles, use the sine, cosine and tangent functions to find missing sides and angles.

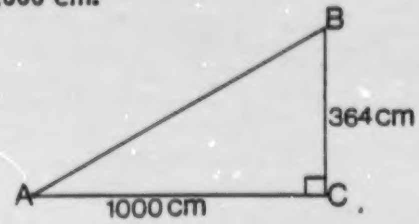
1. In right triangle ABC find side a when angle A = 53° and side b = 200 ft.



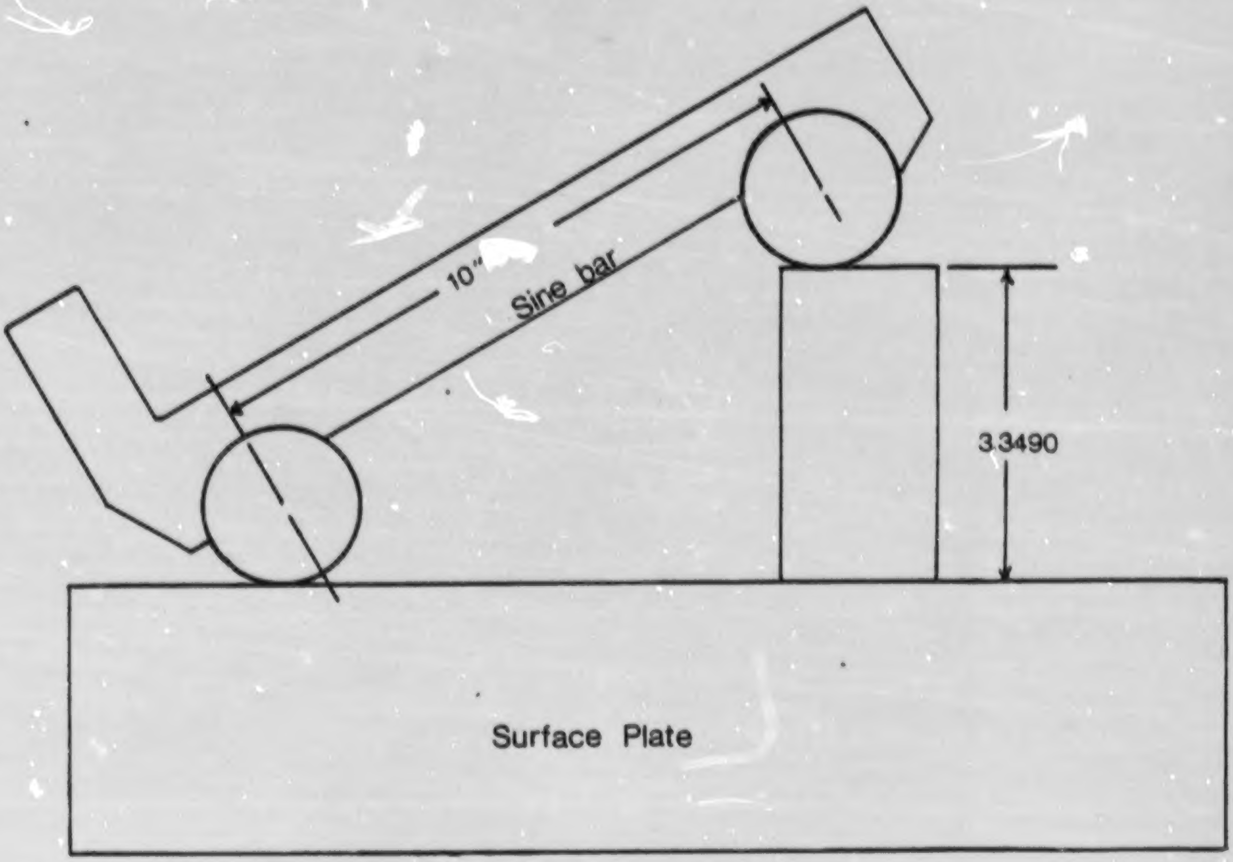
2. In right triangle ABC, find side a when angle B = 77° and side c = 40 feet.



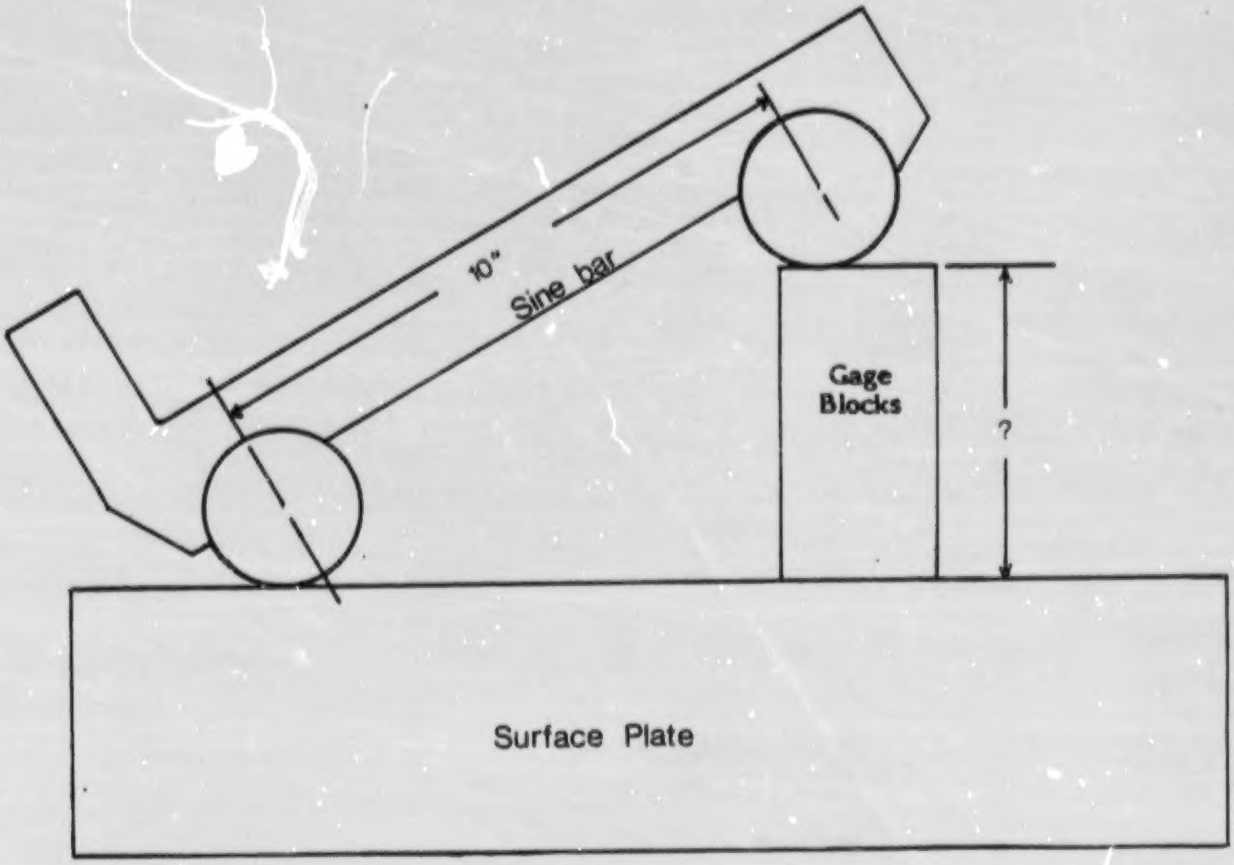
3. In right triangle ABC, find angle A to the nearest degree if side a = 364 cm and side b = 1,000 cm.



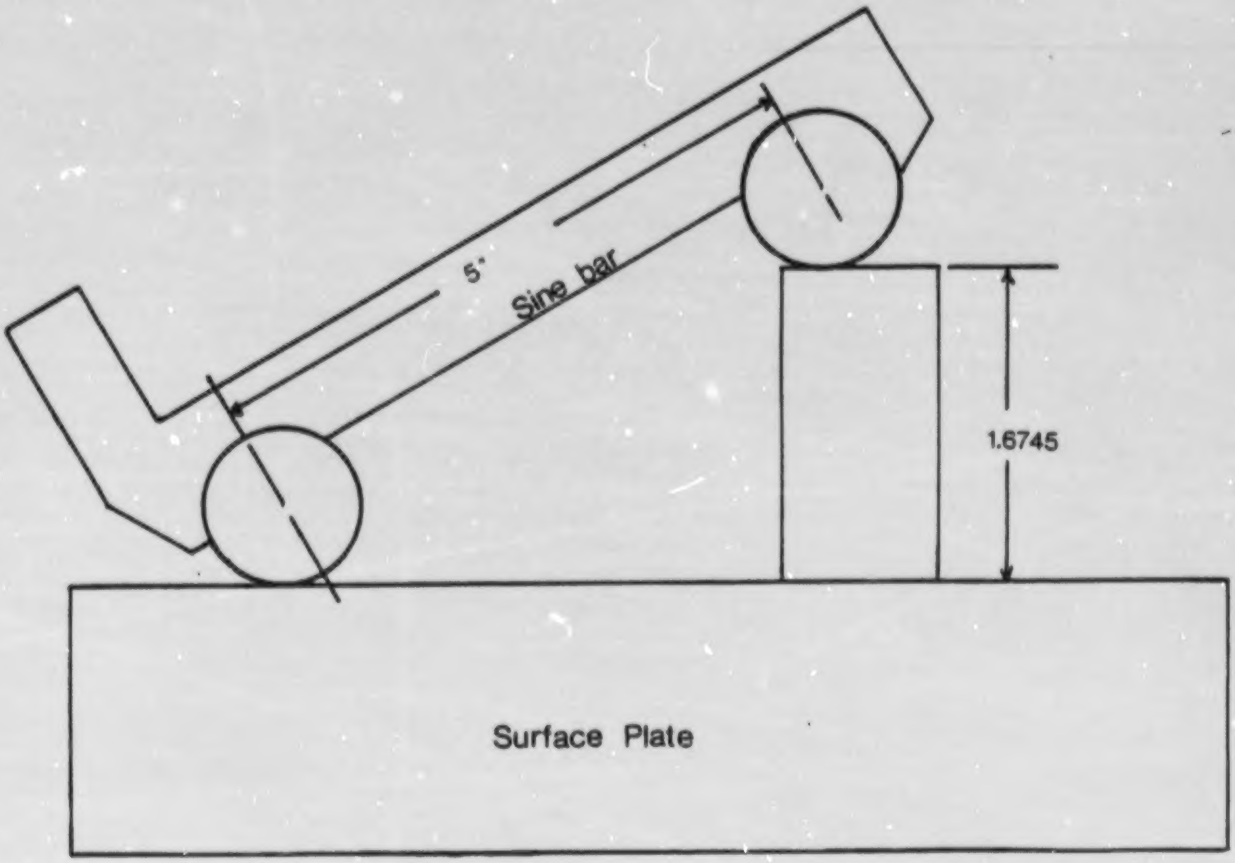
4. Given the height of gage blocks and a Trig table, determine the angle.


10"
Sine bar
3.3490
Surface Plate

5. Given a 10' sine bar, surface plate and gage blocks, and with the use of Trig tables, determine the proper "stacking" of gage blocks to set the sine bar at 28° 10'.


10"
Sine bar
Gage Blocks
?
Surface Plate

6. Given the height of gage blocks and a trig table, determine the angle.


5"
Sine bar
1.6745
Surface Plate

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

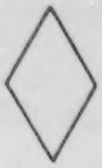
Identify quadrilaterals.

## PERFORMANCE OBJECTIVE #72

Given a set of quadrilaterals, identify each as a parallelogram, square, rectangle, rhombus or trapezoid.

## SAMPLE ITEM

Identify this quadrilateral.



(ans: rhombus)

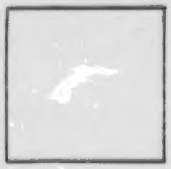
## NOTES

Emphasize shapes that the students see around them.

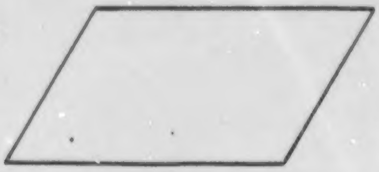
## EVALUATION

Identify each quadrilateral.

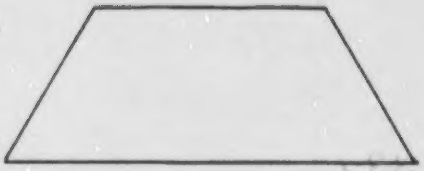
1.



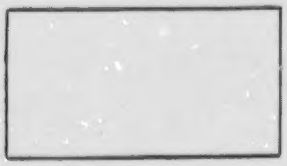
2.



3.



4.



## ANSWERS TO EVALUATION

1. square (also rectangle and parallelogram)
2. parallelogram
3. trapezoid
4. rectangle (also parallelogram)

## ANSWERS TO APPLICATIONS

1. rectangle
   parallelogram
2. trapezoid
3. rhombus
   parallelogram
4. parallelogram
5. square
   rhombus
   rectangle

6. a) Parallelogram
   Proof: Opposite angles are congruent.
   Opposite sides are congruent.
   Pairs of adjacent angles are supplementary.

   b) Square
   Proof: All angles are 90°.
   All sides are equal in length (congruent).

   c) Trapezoid
   Proof: Only one pair of parallel sides exists.

7. Instructor will examine drawings.

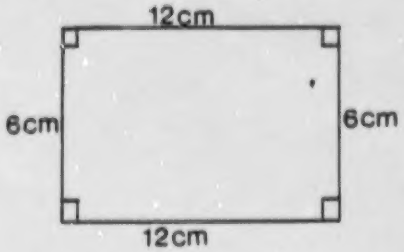
8. a) true
   b) false
   c) true
   d) false
   e) false

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #72

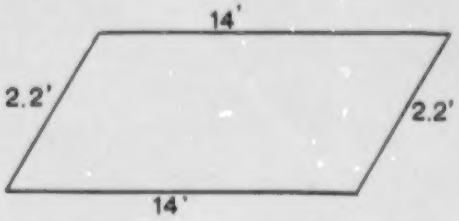
Performance Objective #72: Given a set of quadrilaterals, identify each as a parallelogram, square, rectangle, rhombus or trapezoid.

Identify the following quadrilaterals as a parallelogram, square, rectangle, rhombus or trapezoid.

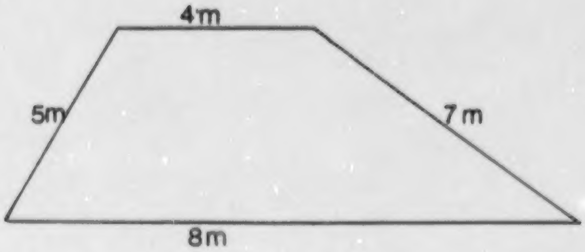
1.


12cm
6cm
6cm
12cm

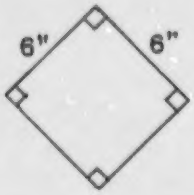
4.



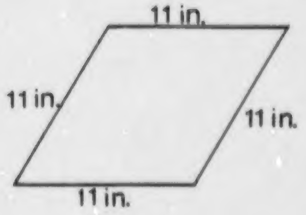
2.



5.

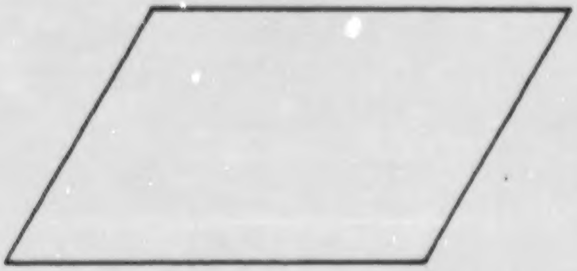


3.

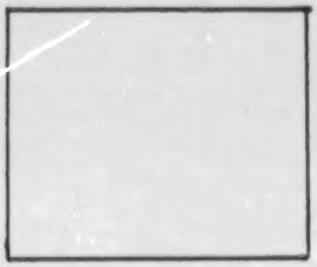

11 in.
11 in.
11 in.
11 in.

6. Based on knowledge about quadrilaterals, measure the angles in the figures below and identify each as parallelogram, square, rectangle, rhombus or trapezoid. Give proof.

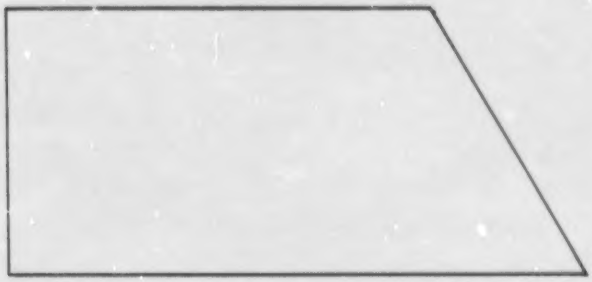
a)



b)



c)



7. Draw one each: a square, a rectangle, a parallelogram, a rhombus, and a trapezoid. Identify each quadrilateral and state the properties of each.

8. Answer true or false.

   a) A square is a rectangle.
   b) A rhombus is a square.
   c) Some rhombi are rectangles.
   d) A trapezoid is a parallelogram.
   e) A parallelogram is a trapezoid.

## APPLIED VOCATIONAL MATHEMATICS

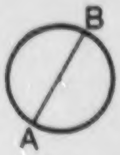
### COMPETENCY

Identify the parts of a circle and tell the characteristics.

### PERFORMANCE OBJECTIVE #73

Given a circle, identify radius, diameter, chords, arcs, central angle and inscribed angle.

### SAMPLE ITEM



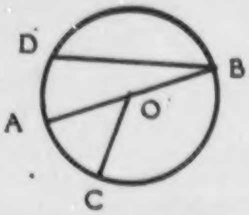
$\overline{AB}$ is called the ________.

(ans: diameter)

### EVALUATION

Identify each of the following.

1. $\overline{DB}$
2. $\overline{AB}$
3. $\overline{OB}$
4. $\angle AOC$



## ANSWERS TO EVALUATION

1. chord
2. diameter
3. radius
4. central angle

## ANSWERS TO APPLICATIONS

1. radius: $\overline{MN}$
   diameter: $\overline{LN}$
   chord: $\overline{XY}$
   arcs: 1-2 or 3-4 are possibilities

2. small diameter: B
   large diameter: A
   arcs: 1-3; 2-4

3. a) radius
   b) diameter
   c) chord
   d) semi-circle

4. a) $\overline{EF}$, $\overline{GH}$, $\overline{HI}$

   b) $\overline{AB}$

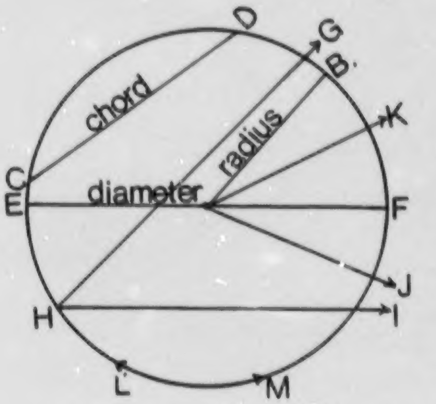
   c) $\overline{CD}$, $\overline{LN}$, $\overline{LM}$, $\overline{MN}$

   d) $\overset{\frown}{KJ}$, $\overset{\frown}{CD}$, $\overset{\frown}{LN}$, $\overset{\frown}{MN}$, $\overset{\frown}{LM}$

   e) ∠GHI

   f) △ LMN

5.



$\overline{AB}$ = radius

$\overline{CD}$ = chord

$\overline{EF}$ = diameter

∠GHI = inscribed angle

∠JAK = central angle

$\overset{\frown}{LM}$ = arc

6. a) $\overline{AE}$, $\overline{AD}$, $\overline{BC}$, $\overline{BE}$

   b) $\overline{BE}$, $\overline{AD}$

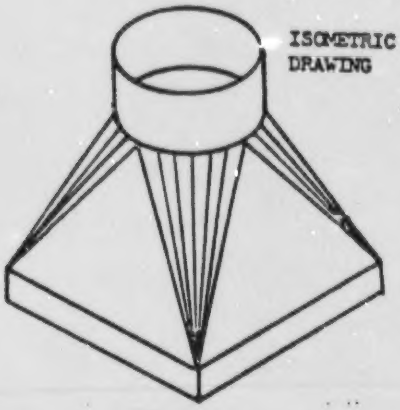
   c) $\overline{AO}$, $\overline{BO}$, $\overline{CO}$, $\overline{DO}$, $\overline{EO}$

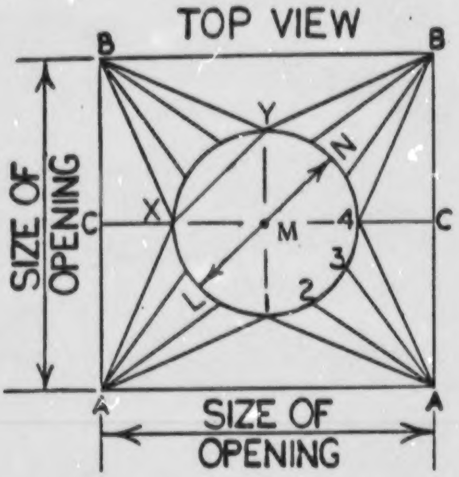
   d) $\overset{\frown}{AB}$, $\overset{\frown}{BC}$, $\overset{\frown}{CD}$, $\overset{\frown}{DE}$, $\overset{\frown}{EA}$ (Others possible also)

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #73

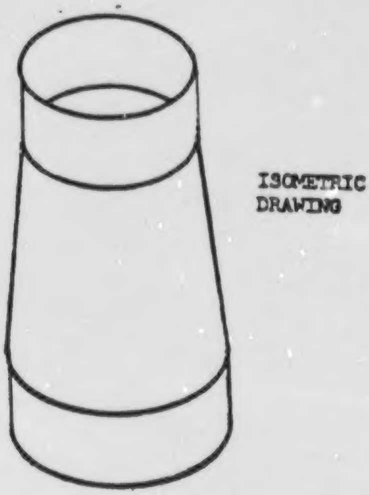
Performance Objective #73: Given a circle, identify radius, diameter, chords, arcs, central angle and inscribed angle.

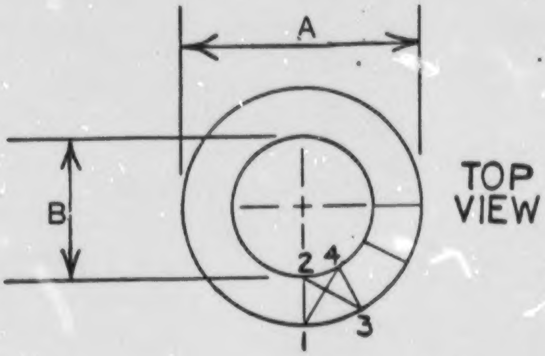
1. When making a square to round fitting, as shown in the isometric drawing, a top view would be developed as shown below. Identify the following: radius, diameter, chord, 2 arcs.


ISOMETRIC
DRAWING

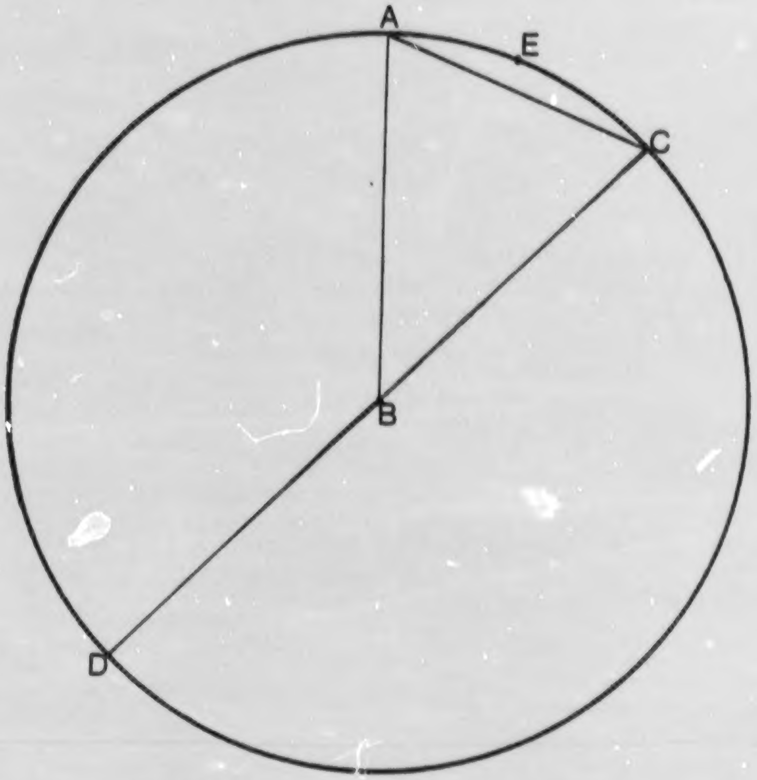

TOP VIEW
B
B
Y
N
X
M
C
C
4
3
2
L
SIZE OF
OPENING
A
A
SIZE OF
OPENING

2. When making a round taper fitting as shown, a top view would be developed as shown below. Identify the following: small diameter, large diameter, 2 arcs.

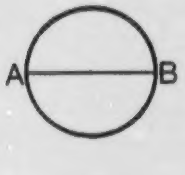

ISOMETRIC
DRAWING

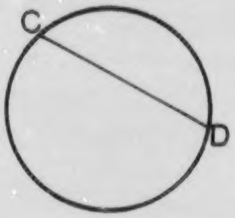

A
B
TOP
VIEW
2
4
3
1

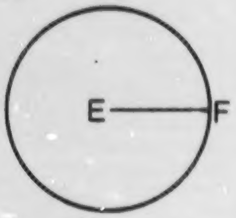
3. Identify:
   a) $\overline{AB}$
   b) $\overline{DC}$
   c) $\overline{AC}$
   d) $\overset{\frown}{DAC}$

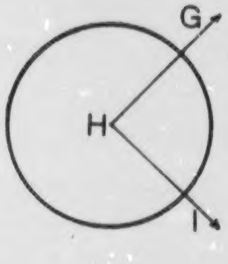


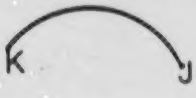
4. Use these figures to name these parts.
   a) a radius
   b) a diameter
   c) a chord
   d) an arc
   e) a central angle
   f) an inscribed triangle

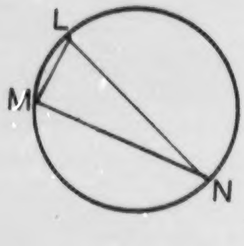






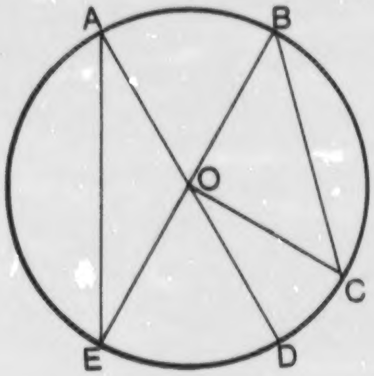






5. Draw a circle with a 2" diameter; show the radius, chord, arc, central angle, and inscribed angle.

6. The drawing below is a circle with several segments drawn inside of it. Answer the questions regarding the circle.



a) Name all the chords in the circle.

b) Name the diameters in the circle.

c) Name all the radii in the circle.

d) Name all the arcs (in order clockwise) in the circle.

## COMPETENCY

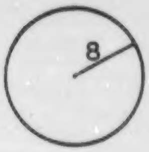
Find the circumference of a circle.

## PERFORMANCE OBJECTIVE #74

Given a circle and the measure of its radius or diameter, find the circumference.

## SAMPLE ITEM

Find the circumference.
(ans: 50.24)



## NOTES

Supply the students with about ten different circular objects. The student will measure the diameter and circumference of each item, then compute the ratio c/d. Have the students do the measures using both customary and metric units. Better precision is attained if a calipe is used to determine the diameter. This activity will lead the students to a better understanding of the value of pi ($\pi$). Many circular objects (cylinders) are formed from flat pieces of material. Knowing how to determine the circumference of the circle is important in order to cut the pieces correctly for forming cylinders.

## EVALUATION

1. How much molding is needed to go around a 48" circular table?
2. How much trim is needed to go around a 2 m circular table cloth?
3. How wide must insulation be cut to go around a 25 cm duct? Allow 3 cm for overlap.
4. What is the circumference of a circle with a radius of 6 inches?

## ANSWERS TO EVALUATION

1. 150.7"
2. 6.28 m
3. 81.5 cm
4. 37.7"

## ANSWERS TO APPLICATIONS

1. 492.98'
2. 5 ft. 2.8"
3. 89.176 cm
4. a) 37.68"
   b) 28.26'
   c) 38.308 cm

5. $A = \pi D = 3.14 \times 6 =$ 18.84"
   1.50" (seam allowance)
   20.34"

   Required: A piece of metal at least 4' x 20.34"

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #74

Performance Objective #74: Given a circle and the measure of its radius or diameter, find the circumference.

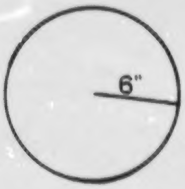
1. What is the circumference of a circle with the radius equal to 78.5 feet?

2. What is the circumference in feet and inches of a circle with a radius of 10 inches?

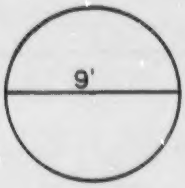
3. What is the circumference of a circle with a radius of 14.2 cm?

4. Find the circumference of the following circles. (Use 3.14 for $\pi$.)

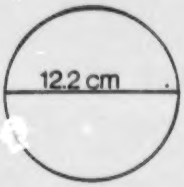
a.



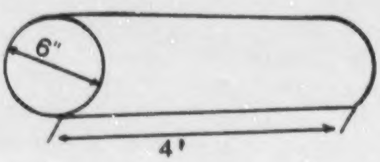
b.



c.



5. A round pipe or duct is to be made from a flat piece of metal. The pipe is to be 4' long and 6" in diameter. One and one half inches are allowed for the seam. What size piece of metal would be required?



# money and time

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Compute salaries.

## PERFORMANCE OBJECTIVE #75

Given a rate of pay, compute a salary for a given pay period.

## SAMPLE ITEM

What is the annual salary for a welder making $975 a month?
(ans: $11,700)

## NOTES

Want ads are a good resource for current pay rates. Students should understand pay schedules such as weekly, bi-weekly, semi-monthly and monthly. This is also a good time to discuss typical deductions and withholdings.

## EVALUATION

1. What is the monthly salary for someone making $14,500 a year?
2. How many pay periods are there in a year for someone paid:
   a) weekly
   b) bi-weekly
   c) semi-monthly
   d) monthly
3. What is the weekly gross pay for someone earning $4.25 an hour for a 38-hour week?
4. What is the annual salary for someone earning $1,430 per month?

## ANSWERS TO EVALUATION

1. $1,208.33
2. a) 52
   b) 26
   c) 24
   d) 12
3. $161.50
4. $17,160

## ANSWERS TO APPLICATIONS

1. $980.40
2. $634.25
3. a) $331.50
   b) $120.77
   c) $210.73
4. 40 x 8.00 = 320.00
   4½ x 12.00 = 54.00
   12 x 16.00 = 192.00
   $566.00
5. a) 12 x 7.50 = 90.00
   4 x 11.25 = 45.00
   10 x 15.00 = 150.00
   $285.00

   b) $7\frac{1}{2} + 8\frac{1}{4} + 8 + 5\frac{3}{4} + 10 = 39\frac{1}{2}$ hrs.

   $39\frac{1}{2} \times 8.16 = \$322.32$
6. base pay = 500.00
   .03 x 4,000.00 = 120.00
   .035 x 1,660.00 = 58.10
   $678.10
7. .065 x 3,210.00 = $208.65

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #75

Performance Objective #75: Given a rate of pay, compute a salary for a given pay period.

1. A welder earns $12.90 per hour for the first 40 hours, and time and a half for overtime. How much would a welder make for 64 hours?

2. A machinist earns $8.60 per hour for the first 36 hours, time and a half for the next 14 hours and double time for all hours over 50 or on Sunday. An employee works the following schedule: Monday — 8 hours 15 minutes; Tuesday — 8 1/2 hours; Wednesday — 7 hours 45 minutes; Thursday — 8 hours; Friday — 4 hours; Saturday — 12 hours; and Sunday — 9 1/2 hours. How much would this employee make for the week?

3. A brick mason who earns $8.50 per hour works 39 hours.
   a) What is the brick mason's gross pay?
   b) Compute the brick mason's total deductions if:
      (1) Federal taxes are 20% of gross pay.
      (2) State taxes are 5% of gross pay.
      (3) Social Security is 6% of gross pay.
      (4) Insurance is $18.
   c) What is the brick mason's net pay?

4. A production worker in a large factory is paid $8.00 per hour for up to 40 hours during regular work days and regular work hours. On holidays and Sunday the rate of pay is twice the regular wage. After 40 hours on regular work days, the rate is 1 1/2 the regular wage. How much will the worker earn during a pay period if he/she works 40 regular hours, 4 1/2 hours overtime (regular work days) and 12 hours overtime (holidays and Sunday)?

5. Determine the salaries of workers described in the problems below.

   a) A truck driver at a regular rate of $7.50:
      12 regular hours
      4 hours overtime, regular work days
      10 hours on Sunday

   b) A factory worker during one week worked the following days. How much will he/she earn at a rate of $8.16 per hour? Monday 7 1/2 hours; Tuesday 8 1/4 hours; Wednesday 8 hours; Thursday 5 3/4 hours; Friday 10 hours.

6. The Oakdale Company pays their salespersons a salary of $500 a month. In addition, a commission of 3% on sales up to $4,000 a month and a 3 1/2% commission on sales over $4,000 per month is paid salespersons. One salesperson's sales totaled $5,660 for one month. What was that salesperson's earnings for the month?

7. Mrs. Smith sold $3,210 worth of hosiery. She was paid a commision of 6 1/2%. How much did she earn?

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Complete invoices.

## PERFORMANCE OBJECTIVE #76

Given an invoice form and the necessary rates and prices, complete the invoice to determine a price estimate or exact cost.

## NOTES

Collect actual invoices for the students to practice completing. Invoices must be completed after each installation or repair is completed. All invoices or bills are approximately the same. If a student can prepare an invoice for equipment, supplies or parts, then this knowledge could be transferred to other areas such as labor, use of equipment, milage costs, etc.

## EVALUATION

Complete the provided invoice with this information.

Customer:

White Printing Co.
803 Main Street
New Town, South Carolina 29803
Order No. 604
Today's Date

| Qty. | Description | Unit Cost |
|---|---|---|
| 1 ea. | Contactor, 2 Pole, 1200 Coil, FLA 60 | \$81.42 |
| 1 ea. | Temperature Control, T4031A, 30° to 50°F, 8 ft. Cap Tube | \$36.53 |
| 2 ea. | Water Regulating Valves, U46AA-1 | \$44.46 |
| 2 ea. | Filter Driers, ASF 2556-V | \$30.06 |
| 2½ lbs. | Refrigerant, R-502 | \$ 3.28 |
| 6½ Hrs. | Labor for Evacuation | \$12.85 |
| 4 Hrs. | Labor for Service and Repair | \$18.50 |

## ANSWERS TO EVALUATION

**phoenix distributors**
700 East San Juan Avenue Phoenix, AZ 85014 (602) 774-3963

*Invoice*

White Printing Co.
803 Main Street
New Town, South Carolina 29803

Date Today's date
Our Order No. 604
Cust. Order No.
Terms
Shipped Via

| Quantity | Description | Unit Price | Total |
|---|---|---|---|
| 1 ea. | Contactor, 2 Pole, 1200 Coil, FLA 60 | \$81.42 | 81.42 |
| 1 ea. | Temperature Control, T4031A, 30° to 50°F, 8 ft. Cap Tube | \$36.53 | 36.53 |
| 2 ea. | Water Regulating Valves, U46AA-1 | \$44.46 | 88.92 |
| 2 ea. | Filter Driers, ASF 2556-V | \$30.06 | 60.12 |
| 2½ lbs. | Refrigerant, R-502 | \$ 3.28 | 8.20 |
| 6½ Hrs. | Labor for Evacuation | \$12.85 | 83.5 |
| 4 Hrs. | Labor for Service and Repair | \$18.50 | 74.00 |
|  |  |  | \$432.72 |

## ANSWERS TO APPLICATIONS NO. 1

phoenix distributors
700 East San Juan Avenue Phoenix, AZ 85014 (602) 774-3963

*Invoice*

Mr. Ralph Love
209 East Street
New Town, South Carolina 29803

Date Today's date
Our Order No. 601
Cust. Order No.
Shipped Via

Terms

| Quantity | Description | Unit Price | Total |
|---|---|---|---|
| 1 ea. | NCH-024AK, Outdoor Unit, S/N Y10163 | $608.61 | 608.61 |
| 1 ea. | NESA-024AO, Indoor Unit, S/N Y9482 | $149.85 | 149.85 |
| 1 ea. | NMEA-035CF, Electric Heat Strips S/N H0407323 | $212.04 | 212.04 |
| 1 ea. | NAXA Thermostat | $ 63.84 | 63.84 |
| 3 ea. | Box, Duct Wrap | $ 43.65 | 130.95 |
| 4 ea. | Tape, 2" Foil | $ 3.63 | 14.52 |
| 2 ea. | Flex Duct, 6", 25 ft. | $ 22.75 | 45.50 |
| 9 ea. | Boot, 4x10x6 | $ 1.89 | 17.01 |
| 9 ea. | Side take Off P62A | $ 2.17 | 19.53 |
| 26 Hrs. - Labor @ $21.75 per hr. | | | $ 565.50 |
| | | | $1,108.43 |

## ANSWERS TO APPLICATIONS NO. 2

**phoenix distributors**
700 East San Juan Avenue Phoenix, AZ 85014 (602) 774-3963

*Invoice*

Mr. A. J. Phipps
Rt. 6, Box 87
New Town, South Carolina 29803

Date Today's Date
Our Order No. 902
Cust. Order No.
Shipped Via
Terms

| Quantity | Description | Unit Price | Tota |
|---|---|---|---|
| 2 ea. | Tape, Duct | $ 4.85 | 9.70 |
| 3 ea. | Staples, Box 9/16 | $ 6.75 | 20.25 |
| 2 ea. | "A" Collars, 14" | $ 1.35 | 2.70 |
| 21 ea. | Strap, Thermostrap, TL84 | $ 0.32 | 6.72 |
| 1 ea. | Bramac Pad, 24 x 52 | $22.06 | 22.06 |
| 11 ea. | Damper, 6" Malco | $ 0.46 | 5.0 |
| 2 ea. | Duct, 18 x 12, 26 ga., 4' | $ 9.02 | 18.04 |
| 6 ea. | Duct, 12 x 8, 26 ga., 4' | $ 8.43 | 50.58 |
| 1 ea. | Transition, 18 x 12 to 12 x 8 | $ 5.21 | 5.21 |
| 3 ea. | EK 052 ALCO | $ 6.96 | 11.88 |
| Delivery charge - 62 miles at $.22 per mile | | | 13.64 |
| Labor - 3 service persons - 4½ hrs each at $8.75 per hr. | | | 39.38 |
| | | | $205.22 |

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #76

Performance Objective #76: Given an invoice form and the necessary rate and prices, complete the invoice to determine a price estimate or exact cost.

Using the blank invoice from Phoenix Distributors, prepare invoices for the following jobs.

1. Customer:

Mr. Ralph Love
209 East Street
New Town, South Carolina 29803
Order No. 601
Today's Date

| Qty. | Description | Unit Cost |
|---|---|---|
| 1 ea. | NCH-024AK, Outdoor Unit, S/N Y10163 | $608.61 |
| 1 ea. | NESA-024AO, Indoor Unit, S/N Y9482 | $149.85 |
| 1 ea. | NMEA-035CF, Electric Heat Strips S/N H0407323 | $212.04 |
| 1 ea. | NAXA Thermostat | $ 63.84 |
| 3 ea. | Box, Duct Wrap | $ 43.65 |
| 4 ea. | Tape, 2" Foil | $ 3.63 |
| 2 ea. | Flex Duct, 6", 25 ft. | $ 22.75 |
| 9 ea. | Boot, 4x10x6 | $ 1.89 |
| 9 ea. | Side Take Off P62A | $ 2.17 |

26 Hrs. — Labor @ $21.75 per hr.

2. Customer:

Mr. A. J. Phipps
Rt. 6, Box 87
New Town, South Carolina 29803
Order No. 902
Today's Date

| Qty. | Description | Unit Price |
|---|---|---|
| 2 ea. | Tape, Duct | $ 4.85 |
| 3 ea. | Staples, Box 9/16 | $ 6.75 |
| 2 ea. | "A" Collars, 14" | $ 1.35 |
| 21 ea. | Strap, Thermostrap, TL84 | $ 0.32 |
| 1 ea. | Bramac Pad, 24 x 52 | $22.06 |
| 11 ea. | Damper, 6" Malco | $ 0.46 |
| 2 ea. | Duct, 18 x 12, 26 ga., 4' | $ 9.02 |
| 6 ea. | Duct, 12 x 8, 26 ga., 4' | $ 8.43 |
| 1 ea. | Transition, 18 x 12 to 12 x 8 | $ 5.21 |
| 3 ea. | EK 052 ALCO | $ 6.96 |

Delivery charge — 62 miles at $.22 per mile

Labor — 3 service persons — 4½ hrs each at $8.75 per hr.

**MASTER COPY**

phoenix distributors

700 East San Juan Avenue Phoenix, AZ 85014 (602) 774-3963

*Invoice*

Date

Our Order No.

Cust. Order No.

Terms

Shipped Via

| Quantity | Description | Unit Price | Total |
|---|---|---|---|
| | | | |

361

# measurement - area and volume

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

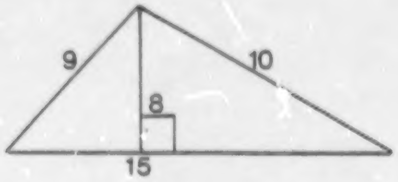
Find the area of a triangle, parallelogram, or circle.

## PERFORMANCE OBJECTIVE #77

Given a triangle, parallelogram, or circle, and the necessary measurements, compute the area.

## SAMPLE ITEM

Find the area.



(ans: 60 square units)

## NOTES

Use the large cardboard figures cut for finding perimeter (P.O. # 18 and # 28) to let the students measure and find the area.

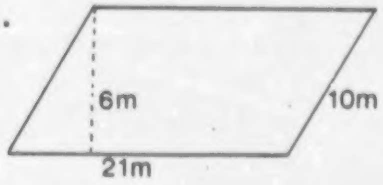
## REFERENCE TO TEXT

**Applied General Mathematics** (AGM), pages 306-317

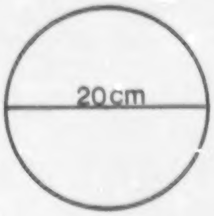
## EVALUATION

Find the area.

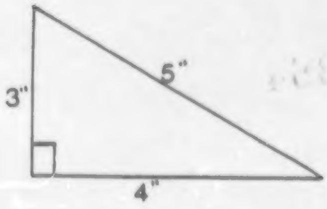
1.



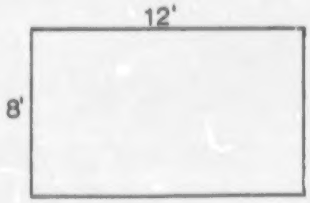
2.



3.



4.



## ANSWERS TO EVALUATION

1. 126 $m^2$
2. 314 $cm^2$
3. 6 sq. in.
4. 96 sq. ft.

## ANSWERS TO APPLICATIONS

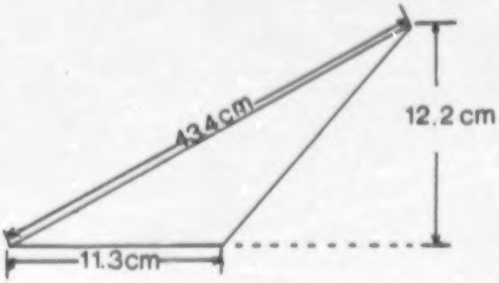
1. 68.93 $cm^2$
2. 63 sq. ft.
3. 52.78 sq. in.
4. a) 78 sq. ft.
   b) 62 sq. ft.
   c) 32 sq. ft.
   d) $3\frac{1}{8}$ sq. in.
5. a) 78.50 sq. in.
   b) 63.6 sq. in.
   c) 707 sq. ft.
   d) 201 sq. in.
6. a) 100 sq. in.
   b) $37\frac{1}{8}$ sq. in.
   c) $82\frac{1}{2}$ sq. in.
   d) 12 sq. ft.

## APPLICATIONS
## FOR
## PERFORMANCE OBJECTIVE #77

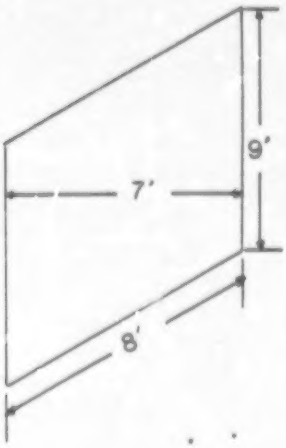
Performance Objective #77: Given a triangle, parallelogram or circle and the necessary measurements, compute the area.

Find the area of the following figures.

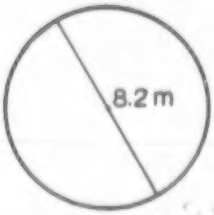
1.


43.4cm
12.2 cm
11.3cm

2.



3.



4. Find the area of a parallelogram with base and height given.
$A = bh$

| | Base | Height |
|---|---|---|
| a) | 12 ft. | 6½ ft. |
| b) | 31 yds. | 6 ft. |
| c) | 8 ft. | 48 in. |
| d) | 2½ in. | 1¼ in. |

5. Find the area of a circle with the radius given.
$A = \pi r^2$

| | Radius |
|---|---|
| a) | 5 in. |
| b) | 4½ in. |
| c) | 15 ft. |
| d) | 8 in. |

6. Find the area of a triangle with the base and height given.
$A = \frac{1}{2} bh$

| | Base | Height |
|---|---|---|
| a) | 12.5 in. | 16 in. |
| b) | 8¼ in. | 9 in. |
| c) | 11 in. | 15 in. |
| d) | 4 ft. | 6 ft. |

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

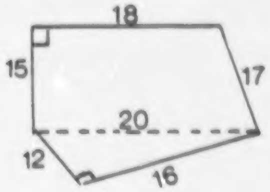
Find the area of irregular figures.

## PERFORMANCE OBJECTIVE #78

Given an irregular polygon and the necessary measurements, subdivide the polygon and compute the area.

## SAMPLE ITEM

Find the area.

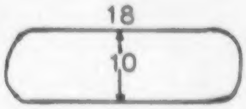

18
15
17
20
12
16

(ans: 381 sq. units)

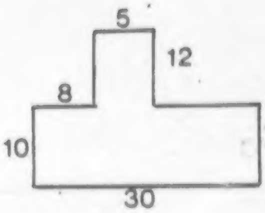
## EVALUATION

Find the area.

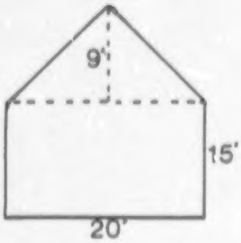
1.



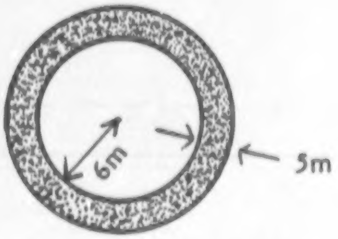
2.



3.



4.



## ANSWERS TO EVALUATION

1. 258.5 sq. units
2. 360 sq. units
3. 390 sq. ft.
4. 267 $m^2$

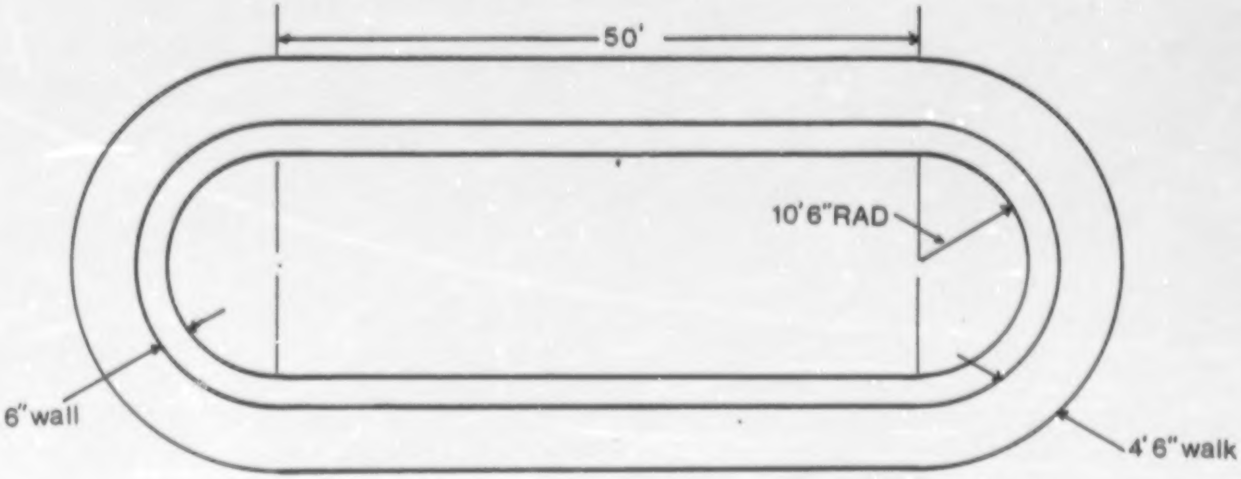
## ANSWERS TO APPLICATIONS

1. 1396.185 sq. ft.
2. 83.755 sq. ft.
3. 824.445 sq. ft.

363

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #78

Performance Objective #78: Given an irregular polygon and the necessary measurements, subdivide the polygon and compute the area.



PLAN OF FLOWER BED

1. What is the area of the inside of the flower bed?
2. What is the area of the top of the wall?
3. What is the area of the walk around the flower bed?

# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

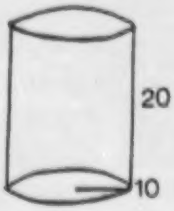
Find the surface area of rectangular solids and cylinders.

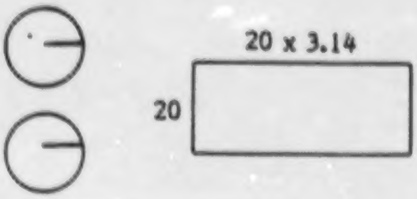
## PERFORMANCE OBJECTIVE #79

Given a rectangular solid or cylinder and the necessary measurements, find the surface area.

## SAMPLE ITEM

Find the surface area:





(ans: 1884 sq. units)

Surface area =
$2 \times 3.14 \times 10^2 + 20 \times 20 \times 3.14$
= 1884 sq. units

## NOTES

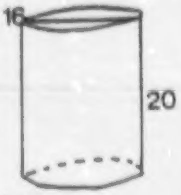
To help students see that the total surface area of a cylinder is a rectangle and two circles, cut an oatmeal box and lay it flat. This also helps the students see that one of the dimensions of the rectangle is the circumference of the base. Helping students visualize these solids and use area formulas they already know is usually an easier method than introducing new and more complicated formulas. When figuring sheet rock needed, find the area of solid walls. Disregard doors and windows.
Knowing the amount of material that is needed is imperative to determining the cost of objects.

## EVALUATION

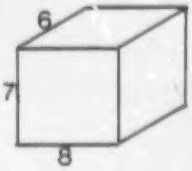
1. A cylindrical water tank is 150 feet tall and 60 feet in diameter. To determine the amount of paint needed, find the area of the sides and top.

2. A rectangular prism has a base 8' x 10' and height 20'. Find the total surface area.

3. Find the total surface area.



4. Find the total surface area.



## ANSWERS TO EVALUATION

1. 33,912 sq. ft.
2. 880 sq. ft.
3. 1406.72 sq. units
4. 292 sq. units

## ANSWERS TO APPLICATIONS

1. a) 472 sq. in.
   b) 70.65 sq. in.
   c) 603 $cm^2$
   d) 30,133 $mm^2$
2. 696 sq. ft.
3. 62.8 sq. ft.
4. H x L = 6" x 4' = ½' x 4' = 2 sq. ft.
   H x L = 6" x 4' = ½' x 4' = 2 sq. ft.
   W x L = 12" x 4' = 1' x 4' = 4 sq. ft.
   W x L = 12" x 4' = 1' x 4' = 4 sq. ft.
   12 sq. ft. x 2 = 24 sq. ft.

   Repeat for each

   12" x 12" = 1 + 1 + 1' + 1' x 4' = 4 x 4 = 16 x 2 = 32 sq. ft.
   12" x 18" = 1 + 1 + 1½ + 1½ x 4' = 5 x 4 = 20 x 2 = 40 sq. ft.
   96 sq. ft.

   96 sq. ft. x 1.25 = 120 sq. ft. total

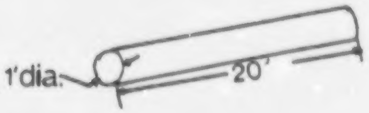
# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVE #79

Performance Objective #79: Given a rectangular solid or cylinder and the necessary measurements, find the surface area.

1. Determine the surface area of a cylinder with the radii and heights given.
   a) r = 5"; h = 10"
   b) r = 1.5"; h = 6"
   c) r = 6 cm; h = 10 cm
   d) r = 40 mm; h = 80 mm

2. Figure the number of square feet of sheet rock in the walls and ceiling of a room 12' by 18' with a 8' ceiling.

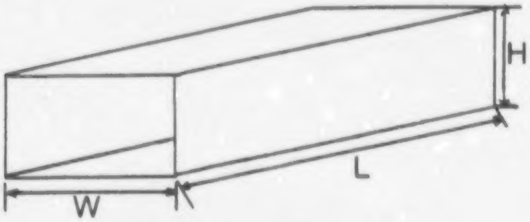
3. How many square feet of sheet metal will it take to make a 20' circular duct with 1' diameter?



4. Six pieces of metal duct are to be made for an air conditioning system. All six pieces will be 4 ft. long. The size of the duct will be as follows:

   6" x 12" (2 each)
   12" x 12" (2 each)
   12" x 18" ( 2 each)

   An extra 25% must be added for waste when cutting. How many square feet of metal is needed?



# APPLIED VOCATIONAL MATHEMATICS

## COMPETENCY

Find the volume of rectangular solids and cylinders.

## PERFORMANCE OBJECTIVE #80

Given a rectangular solid or cylinder and one necessary measurement, find the volume.

## SAMPLE ITEM

How many cubic yards of cement are needed for a driveway that is 12' by 22' by 6"?

(ans: 4.9 cubic yds.)

## NOTES

An air conditioning service person must be able to compute volumes of cylinders and rectangular tanks such as those used for cooling towers. One should keep in mind when ordering concrete that you should not round off but round up to the nearest half yard. For example, if computations show you need 3.2 cu. yds., order 3.5 cubic yards.

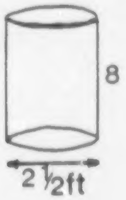
## REFERENCE TO TEXT

**Applied General Mathematics** (AGM), pages 319-329

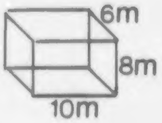
## EVALUATION

Find the volume.

1.



2.



3. A cube 3 ft. to a side

4. A room 8 ft. x 10 ft. x 12 ft.

## ANSWERS TO EVALUATION

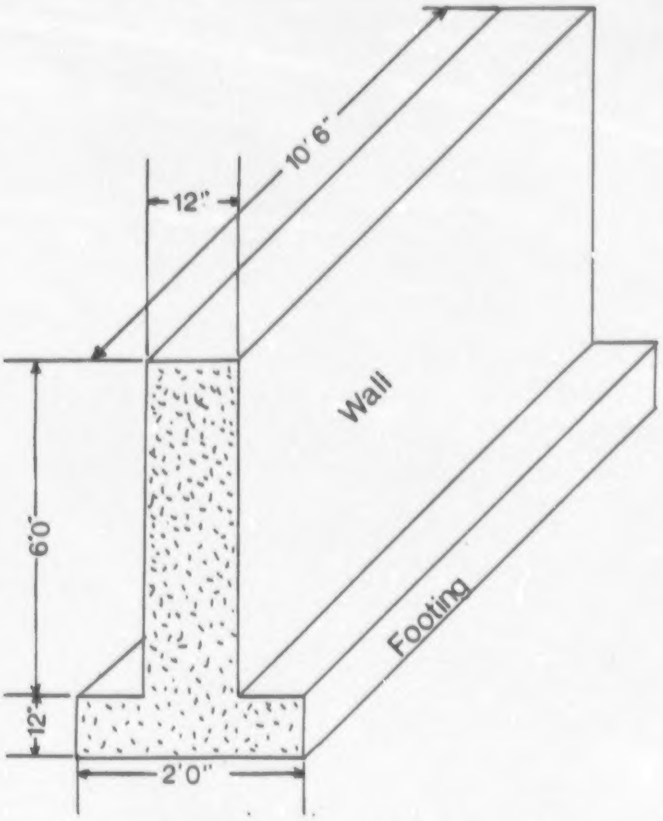
1. 39.3 cubic ft.
2. 480 $m^3$
3. 27 cu. ft.
4. 960 cu. ft.

## ANSWERS TO APPLICATIONS

1. 21 cu. ft.
2. 63 cu. ft.
3. Need 3.111 cu. yds.
4. 72 cu. ft.
5. 8 cu. ft.
6. a) 648 cu. yds.
   b) 5.47 cu. ft.
   c) 71 3/4 cu. in.
   d) 47.19 $cm^3$
   e) 33.75 cu. yds.

# APPLICATIONS
# FOR
# PERFORMANCE OBJECTIVF #80

Performance Objective #80: Given a rectangular solid or cylinder and one necessary measurement, find the volume.



1. How many cubic feet of concrete does the footing contain?

2. How many cubic feet of concrete does the foundation wall contain?

3. How many cubic yards of concrete should be ordered to pour both the footing and the foundation wall?

4. A cooling tower has a tank that is 12 ft. long, 12 in. high and 6 ft. wide. What is the volume of the tank in cubic feet?

5. A concrete pad is to be poured to support a condensing unit. The pad is 6 ft. x 4 ft. x 4 in. How many cubic feet of concrete will be required?

6. Find the volume of a rectangular solid with length, width and height given.

|  | Length | Width | Height |
|---|---|---|---|
| a) | 27 yds. | 12 yds. | 2 yds. |
| b) | 2.5 ft. | 1.75 ft. | 1.25 ft. |
| c) | 10¼ in. | 3½ in. | 2 in. |
| d) | 5.5 cm | 3.9 cm | 2.2 cm |
| e) | 6 yds. | 4.5 yds. | 1.25 yds. |

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